Power Engineering

OCTOBER, 1952

Volume 56, No. 10 Circulation of this issue 25,750

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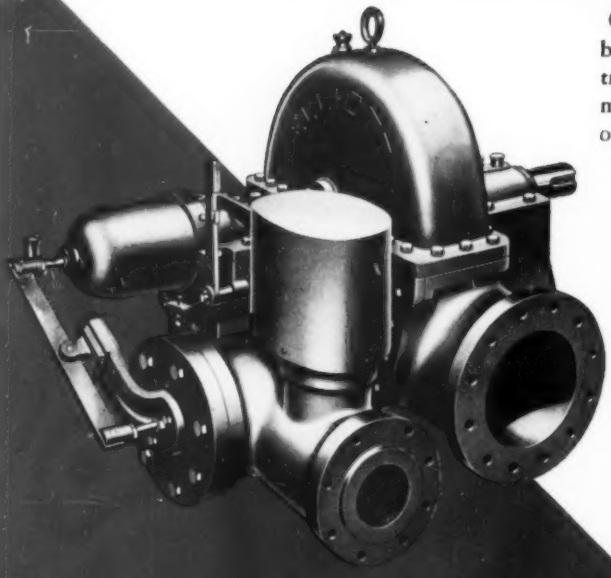
TECHNICAL PUBLISHING COMPANY • CHICAGO, ILLINOIS

Both strong in

YR Turbines

ELLI



This turbine makes friends everywhere, in all industries, for its tailor-made adaptability, its simplicity, its extremely reliable performance, its surprisingly low maintenance—all qualities of highest value. Capacities to 2000 hp. Speeds, 800-7000 rpm.

●YR Turbines are built on a production basis, but engineered to allow an extremely wide range of modifications to meet specific conditions. Here are some of them:

- **Five frame sizes—**
- **Eight different turbine types—**
- **Your choice of several governors each independent of the standard overspeed governor—**
- **Six elective control devices, including:**

1. Two hand valves controlling nozzling
2. Hand-operated speed changer
3. Remote control speed changer, air or electric
4. High exhaust pressure trip
5. Remote control electrical trip
6. Hand throttled emergency trip valve.

- **Gland seal piping for condensing operation, or operation with gas—**
- **Exhaust connection on either side.**

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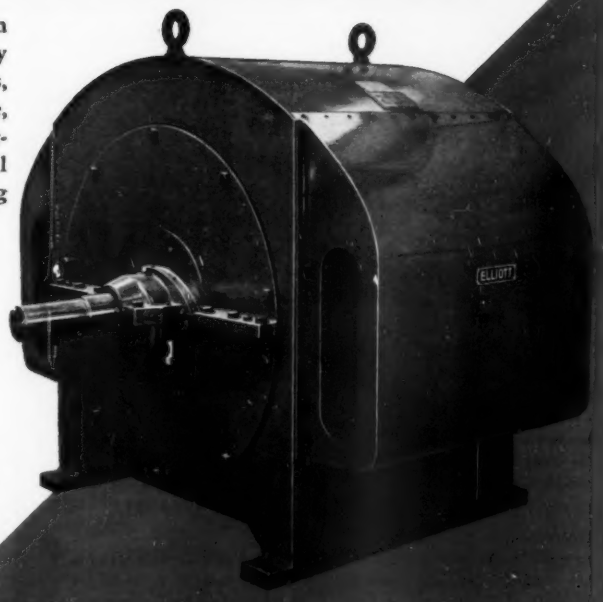
adaptability!

OTT Fabri-steel motors

● Fabri-steel motors have established an entirely new set of standards in their easy applicability to individual conditions, some of them most difficult. For instance, the standard Elliott squirrel-cage induction motor, without change in electrical design, can be supplied with the following enclosures:

1. Outdoor splashproof
2. Vertical outdoor splashproof
3. Indoor splashproof
4. Frame modified for top discharge
5. Enclosed self-(base) ventilcted
6. Totally enclosed, fan-cooled with top-mounted air-to-air heat exchanger
7. Totally enclosed, water-cooled with side-mounted air-to-water heat exchanger
8. Round frame for mounting inside a duct system with a forced-draft fan impeller mounted on tapered shaft extension.



Above is shown the Elliott splash-proof squirrel-cage induction motor, designed for outdoor service, and proven immune to the effects of rain, sleet, hail, fog, snow, sand, dust and temperature extremes. This motor provides new economy in cost of housing eliminated, and new convenience in locating installations. It requires no special foundation beyond a simple concrete slab. This motor is typical of Elliott advanced thinking in motor engineering.

Get complete data on this and other Elliott motors.

Company

DEPT. PE RIDGWAY DIVISION • RIDGWAY, PA.

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PRINCIPAL CITIES

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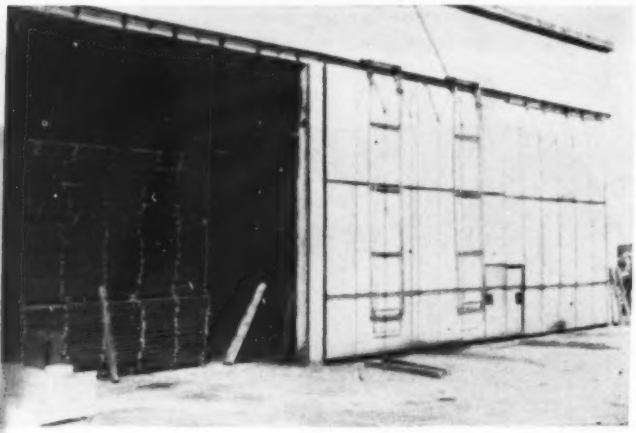
4 Traps Increase Capacity 8%



▲ One Armstrong No. 215 inverted bucket steam trap is used on each of the four dry kiln coils at Wells-Oates Lumber Co., New Bern, N. C.

◀ The time cycle on this lumber dry kiln was reduced from 72 to 66 hours by Armstrong Unit Trapping.

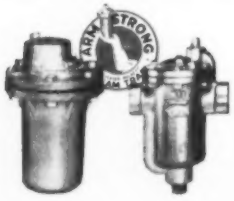
OFTEN a large capital investment in steam heated equipment is not utilized fully simply through failure to drain condensate and air efficiently. Here is a typical case:

Wells-Oates Lumber Co., New Bern, N. C., recently made one of the finest and most modern dry kiln installations possible. And it worked fine. But, it works better now, thanks to the installation of an individual Armstrong steam trap on each of the four steam coils in the kiln. The kiln cycle time has been reduced from 72 hours to 66 hours. The capacity has thereby been increased over 8% by an investment in traps of only a little over $200.

The trap installation was made upon the recommendation of DeWitt H. Skinner of Allan T. Shepherd Co., the local Armstrong Representative. The reason behind his recommendation made sense to the Wells-Oates people —*"with one trap on each of the four coils of the kiln, all coils would be properly purged of condensate and air and it would, therefore be impossible for one coil to influence the operation of another coil." The results proved the point.*

Your local Armstrong Representative may be able to show you how to get more out of your steam heated equipment. Remember, he sells a product that is *guaranted to satisfy. Call him or write:*

You always get more out of equipment when you use Armstrong "Unit Trapping"



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Phone: DEarborn 2-5446

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Oscar Wilds
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OCTOBER 1952
VOL. 56 • NO. 10

Stator sections for a big Westinghouse water-wheel generator look like slices of power

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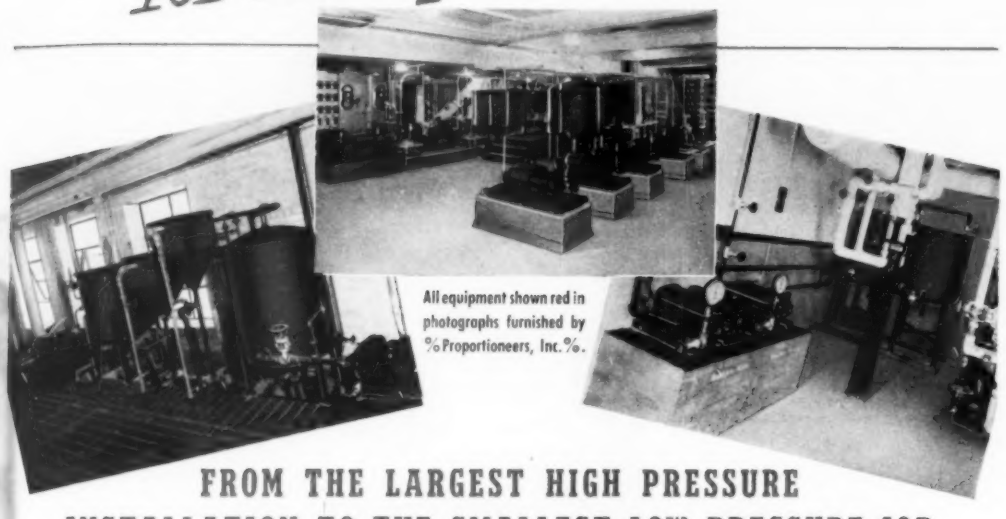
CHEMICAL TREATMENT METERING PUMPS

for Every Power Plant



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ENGINEERS' PREVIEW

E. Parish (Pat) Lovejoy, director of Detroit Edison Company's Public Information Division, will be missed around Detroit Edison for the next year. He has been granted a year's leave of absence requested for reasons of health. Appointed to take up his duties is George H. Tuttle, an Edison man since 1927, who recently returned to the company after a six month loan assignment as a Defense Electric Power Administration consultant in Washington, D. C.

★ ★ ★

William Rogers Herod has been elected a vice president of the General Electric Company and will continue as president of the International General Electric Company which he has headed since 1945.

At the same time, it was announced that the International General Electric Company, Incorporated, which has been a wholly-owned affiliate of General Electric since 1919, will, on July 31, be merged with and become a division of the General Electric Company. As a division of the parent company, the International General Electric Company will retain that name and continue to have the same responsibility for the conduct of the foreign business of the company. Herod and the other officers of the former affiliate will retain their titles and continue in the same capacities.

★ ★ ★

Donald R. Jenkins will be manager of the newly-formed gas turbine application engineering section of the Steam Division of the Westinghouse Electric Corporation at South Philadelphia, Pa. The section was formed recently to handle all Company negotiations involving gas turbines for land and marine service.

Mr. Jenkins has been with Westinghouse since 1940, when he joined the Company's graduate student training course following his graduation from the University of Utah at Salt Lake City. He has held numerous engineering posts with the Company in Pittsburgh, Philadelphia, and Los Angeles. Since February, 1951, he has been an application engineer in the electric utility department of the Company's district office in Salt Lake City.

★ ★ ★

The 200,000-kw generator being built by the Westinghouse Electric Corporation for the Philadelphia Electric Company will utilize inner-cooling in both its rotor and stator, it was disclosed recently. Scheduled for shipment to the Cromby station in 1954, the generator will bring the station's capacity to 350,000 kw.

Inner cooling makes use of hollow generator conductors through which the hydrogen gas is passed. Bringing the hydrogen in direct contact with the copper conductors increases the cooling effect of the gas to such an extent that considerably less copper and steel is needed per kilowatt of generator output.

The 200,000-kw turbine-generator will be the largest single-shaft unit ever built.

★ ★ ★

A Fellowship for conducting systematic studies of standardization and its applications in science, engineering, production and marketing will be established at Mellon Institute, Pittsburgh, Pa. This Fellowship will be sustained at the Institute by a grant from the Sarah Mellon Scaife Foundation of Pittsburgh, and its projects will be organized and supervised by Dr. Dickson Reck, Advisory Fellow. Dr. Reck will work in cooperation with research specialists of the Institute and with national authorities and societies.

★ ★ ★

Iron ore is mined beneath the sea more than two miles from shore near Bell Island, Newfoundland, according to American Iron and Steel Institute. A system of belt conveyors is being installed to help bring the ore from beneath Conception Bay to the surface on the island. The system will be able to lift 1000 tons of ore an hour from a depth of 1730 ft. According to a published report this Wabana Mine is expected to supply 2,-800,000 tons of ore in 1952.

★ ★ ★

The Philadelphia Electric Company recently initiated the use of a new aerial photo method to inventory "fuel on hand" in their enormous coal stockpiles. This new air survey system, used to check more than 500,000 tons of coal stored in ten different locations, obtained the inventory figures in days instead of weeks, and cut inventory costs by 25 per cent.

The survey plane flew over the stockpiles at a set altitude. Using a precise timing device on their camera, they took two pictures of each seventy-five acre section, at slightly different angles. In this way, three-dimensional views of the terrain were obtained photographically, and the contours of each coal pile were shown exactly. Special plotting equipment quickly established the cubic volume of coal in each pile.

When rechecked, this modern scientific method of aerial coal inventory, in addition to being much faster and less expensive, proved to be accurate to within 3-5 per cent.

★ ★ ★

A new method of highly accurate analysis of various materials by means of atomic energy is now available at Oak Ridge as a service to industrial, scientific and medical groups.

Developed by scientists at Oak Ridge National Laboratory, the technique permits detection and measurement of impurities in foods, pharmaceuticals, metals and other materials, and may help manufacturers improve the purity of their final products.

The service is offered by Carbide and Carbon Chemicals Co., a division of Union Carbide and Carbon Corp., which operates ORNL for the Atomic Energy Commission.

★ ★ ★

Battelle Institute, Columbus, Ohio, will have soon a new million-dollar "special purpose" laboratory building. Construction was authorized by the NPA because of the important defense research being conducted at Battelle.

Some 300 industrial firms, in addition to the Air Force, Army, Navy, and Atomic Energy Commission, are sponsoring important research studies at Battelle. Director Clyde Williams estimates that in the space provided by the new building, Battelle will be in a position to conduct an additional $2,000,000 worth of research for defense agencies and defense industry.

The new building will be of a specially reinforced-concrete construction designed to minimize vibration because the building will be occupied by research personnel working in electronics and other fields of research where delicate measurements are essential.

★ ★ ★

The Council for Technological Advancement will assist the Machinery and Allied Products Institute in the execution of its specialized and concentrated program in the interests of capital goods and industrial equipment producers and the public welfare. Its purpose will be to program, to pioneer, and to promote ideas for a more dynamic economy.

The Council will undertake activities in the long-range interest of technological advancement which MAPI alone cannot initiate for an indefinite period without disservice to other pressing needs. Also, it will accelerate MAPI's program by providing new centers for study and action which will place at work an additional number of alert minds through its Board of Trustees and committees.

★ ★ ★

One of the biggest birthday parties to be held anywhere this year — 12,000 guests in five hotels — will be the 40th annual National Safety Congress in Chicago, Oct. 20-24.

The Congress is the annual convention of members of the National Safety Council. Through the Congress emphasis will be placed on the progress that has been made in accident prevention in the four decades that have followed the first

Congress in Milwaukee. But no effort will be made to minimize the size of the accident toll today and the huge problem it presents.

★ ★ ★

The Contracting Division of Dravo Corporation, Pittsburgh, has completed the construction of water intake facilities in the Delaware River at Gibbstown, New Jersey, which will serve the new Greenwich steam and by-product electric generating station of the Atlantic City Electric Company.

Because the river is too shallow near the shore to provide sufficient quantities of water necessary to operate the steam and by-product station, a 60-in. diameter steel pipe line was built 662 feet out into the river.

The river intake consists of steel sheet piling driven to form a rectangular structure around the end of the pipe. Flanking this structure, up and downstream, are two 27-ft diameter steel sheet pile cells. These are to protect the intake from damage by floating debris.

Incorporated with the Greenwich Station is a river pump house with an initial capacity of approximately 15,000 gpm. Provisions are incorporated in the design for an ultimate capacity of 40,000 gpm.

Steam and water will be used for the requirements of the Rapano Plant of the E. I. duPont de Nemours Co. at Gibbstown.

★ ★ ★

Martin A. Elliott, chief of the synthetic fuels research branch at the U. S. Bureau of Mines, Pittsburgh, Pa., will be research professor of mechanical engineering at Illinois Institute of Technology, Chicago. Dr. Elliott's most recent work at the Bureau of Mines, where he has been employed since 1938, was supervising research and development on synthetic liquid fuels.

★ ★ ★

Lloyd J. Westin will be the new District Manager, with offices at Graybar Bldg., New York, N. Y. for Union Iron Works, Erie, Pa., manufacturers. Mr. Westin replaces Wirt D. Seeley who has resigned because of continued ill health.

Mr. Westin is a registered Professional Engineer, member of the ASME and American Society of Naval Engineers. His experience includes executive sales engineering at Westinghouse, American Engineering Co., Day & Zimmerman, Inc., John Phillips Badenhousen, Inc. and the Home Office of Union Iron Works.

★ ★ ★

Herbert F. Roemmele (103 Robert Ave, Port Chester, N. Y.) will be the new president of the New York Chapter of the New York State Society of Professional Engineers elected at their annual meeting at the Hotel Statler, New York.

For the past 25 years Professor Roemmele has served on the faculty of Cooper Union's School of Engineering where he is professor of mechanical engineering and dean of students. Since 1948, he has also served as director of industrial relations at The Cooper Union. Prior to his faculty appointment at Cooper, Professor Roemmele worked as a test engineer with the General Electric Company.

In addition to his academic duties, Professor Roemmele acts as chairman of the New York Engineers Committee on Student Guidance of the American Society of Mechanical Engineers. He is also chairman of the ECPC Student Guidance on Engineering Committee in the Regent II area (New York and New Jersey).

★ ★ ★

L. F. Hickernell, chief engineer of the Anaconda Wire & Cable Co., Hastings-on-Hudson, New York, will be Chairman of the newly formed Committee on Technical Operations of the American Institute of Electrical Engineers.

The new committee will be coordinating agency for the AIEE's five technical divisions, which represent 38 technical committees; and will supervise all technical affairs of the Institute.

★ ★ ★

Smoke Is Abated in the Firebox; Not in the Courtroom! That is the motto of Smoke Regulation Engineer Raymond E. Wetzel of Evansville, Indiana. It simply means that instead of trying to drag a smoke violator promptly into court, Mr. Wetzel begins by getting together with the violator to determine the cause of the smoke and, if possible, to help him remove the cause. How well this system has worked you can read in the July 1 issue of the Coal Producers Committee for Smoke Abatement *Review*.

★ ★ ★

Two new instruction texts on hydraulics will be available to International Correspondence Schools courses in Mechanical, Chemical, and Electrical Engineering. They were written by Archibald L. DeGroot, member ASCE, director of the ICS Civil Engineering School.

Part One covers the nature of liquid flow, energy of liquids and various theorems and formulas. Part Two deals with machines for developing water power and their problems.

The texts on Hydraulics are also available under the ICS Selective Plan which permits employers to select only those subjects required to achieve specific training objectives for certain picked personnel.

★ ★ ★

David F. Shaw, manager of the Hanford Operations Office of the Atomic Energy Commission, announced negotiations have been completed with Kaiser Engineers, a division of Henry J. Kaiser Co., for construction of a large part of the new expansion program on the Hanford plutonium production project. Construction work in the expansion program will be divided into two or more projects.

Contracts for designing the new plants have been signed with Vitro Corp. of America, New York City, and the Charles T. Main Co. of Boston. The General Electric Co., operating contractor of Hanford Works, will furnish basic engineering design for the program and will do complete design of certain very complex features of the expansion.

★ ★ ★

Two years of transportation planning will be climaxed with the delivery of a giant General Electric 401,000-lb stator for one of the world's largest generators in Consolidated Edison's East River Station at New York City.

Two railroads, a specially-built flatcar, one of the world's largest marine derricks, a lighter (special barge), three tugboats, and a Manhattan firm of heavy hauling specialists will be called upon to move the giant 30-ft long component of the 175,000 kw generator.

★ ★ ★

The Niagara Mohawk Power Co. will install an 80,000-kw, 3600-rpm inner-cooled generator built by the Westinghouse Electric Corp. The unit has been bought, and is scheduled for shipment to the utility's Huntley station next March, and will be the first to employ the new inner cooling technique in both the rotor and stator.

Inner cooling, announced last fall, consists of passing the hydrogen gas through specially-constructed hollow coils.

★ ★ ★

The Stoker Manufacturers Association will have a new president for the ensuing year. Leroy C. Dubs, Canton Stoker Corp. was elected president.

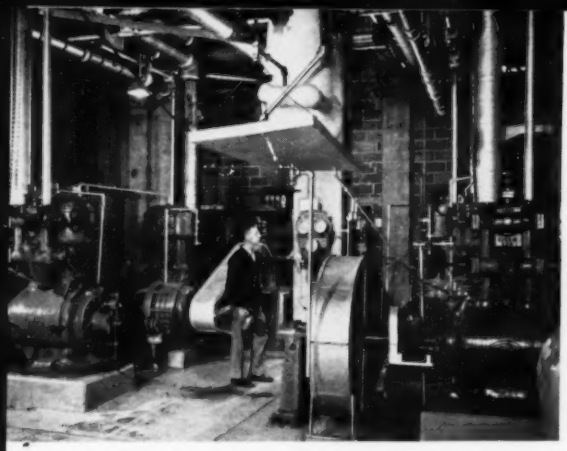
B. O. Fink, Auburn, Ind., president of the Auburn Foundry, Inc., was elected vice president and Howard B. Scoville, Rockford, Ill., assistant general manager, Cotta Transmission Co., was elected secretary-treasurer. Marc G. Bluth, Chicago, was re-appointed executive secretary.

★ ★ ★

Dr. Everard M. Williams, voted the outstanding young electrical engineer of the United States in 1946, will be the new Head of the Department of Electrical Engineering at Carnegie Institute of Technology.

Designer of the oscillator and deflector for the Carnegie Tech 2½-million-dollar synchro-cyclotron, Dr. Williams has been a member of the Carnegie faculty since 1945. He was made professor of electrical engineering in 1949.

During the war years, Dr. Williams served as branch (chief) engineer with the Development Branch Special Projects Laboratory at Wright Field. There he worked on radar, development of radio countermeasures, radio control for guided missiles, and infrared systems. In recognition of his achievement, Dr. Williams was presented the President's Certificate of Merit for "outstanding fidelity and meritorious conduct in aid of the war effort — in World War II."



COMPRESSOR EFFICIENCY UP 15%. Six years ago, these Frick compressors were losing efficiency because the oil formed excessive lacquer and carbon deposits. Clogged lines made frequent overhauls necessary. The company changed to Suniso Refrigeration Oil and its natural detergency immediately began attacking the deposits throughout the system. The carbon and lacquer deposits were rapidly carried away to traps and filters, and the system was soon entirely cleaned. Since then compressor efficiency has increased 15%.

SLUDGE AND WAX ELIMINATED. A firm engaged in constructing and servicing industrial refrigeration equipment had constant trouble with compressor oils. Every oil tried lost viscosity excessively under high operating temperatures, vaporized and formed sludge, or formed wax at low temperatures. Complaints were numerous and time lost on call-backs was costly. After consulting compressor manufacturers, the company switched to Suniso. This product immediately solved all sludge, wax and low temperature problems.

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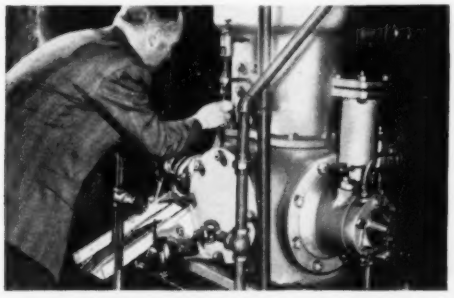
Suniso Refrigeration Oils meet the requirements of *all* compressors and *all* refrigerants. To get more information, just fill in and mail the coupon below.



SEPARATION TROUBLE ENDED. In this 15-ton ammonia compressor, the oil discolored badly and failed to separate properly from the refrigerant. Excessive amounts of oil carried over into the separators, lowering the efficiency of the entire system. With a switch to Suniso, separation, carryover and discoloration problems ended.

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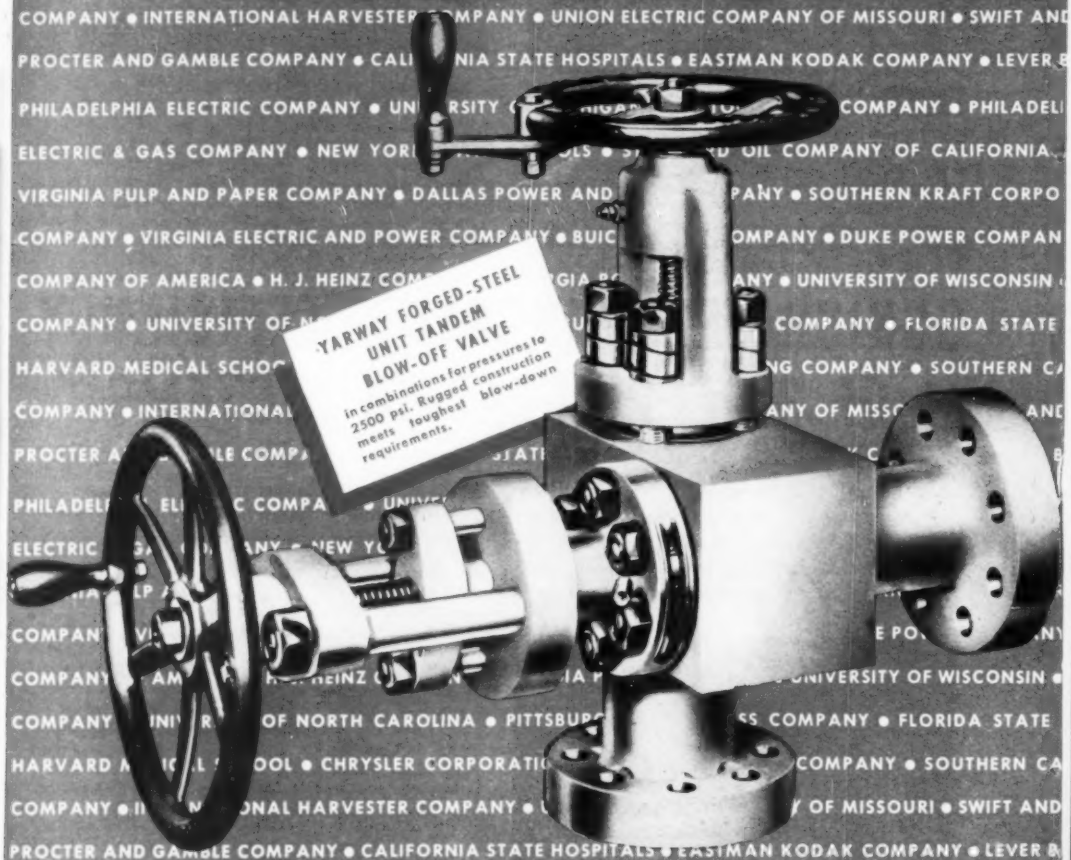
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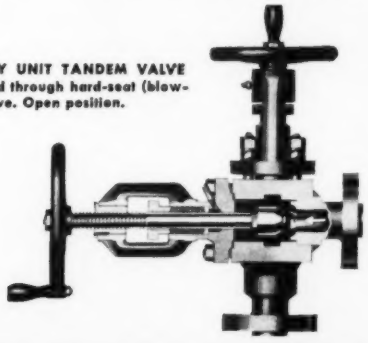
Yarway continues to pioneer and improve blow-off valves and blow-off valve service for both high and low pressure applications.

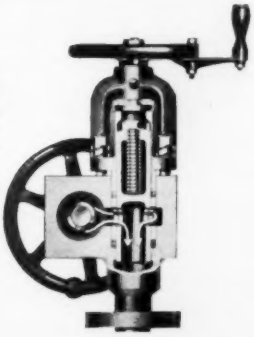
On new boilers, replacements or modernization, make sure you specify Yarway Blow-Off Valves. Any boiler manufacturer will supply them on your specification.

Bulletin B-424 gives you the full story on pressures to 400 psi. Bulletin B-433 for higher pressures. Both are free. Write...

YARNALL-WARING COMPANY, 114 Mermaid Ave., Philadelphia 18, Pa.



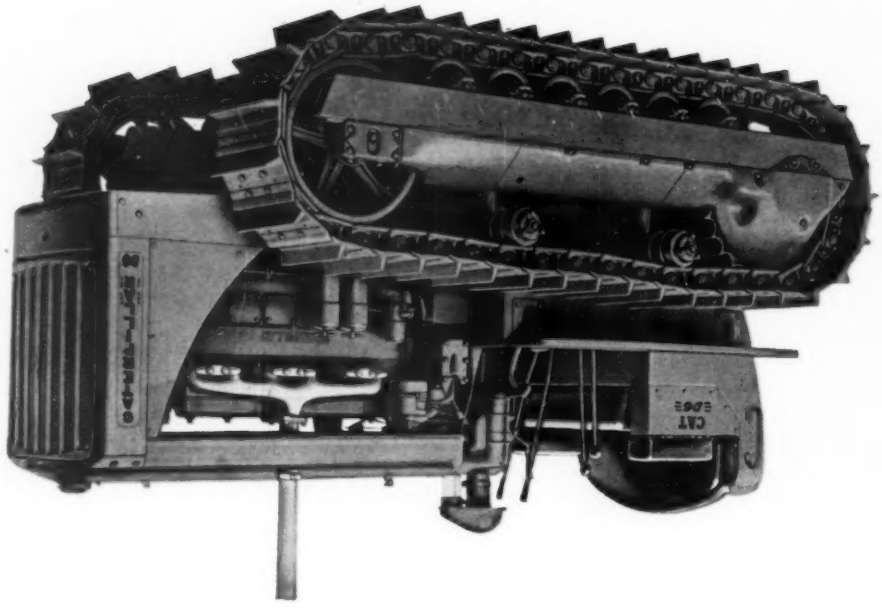
YARWAY UNIT TANDEM VALVE sectioned through hard-seat (blowing) valve. Open position.



YARWAY UNIT TANDEM VALVE sectioned through seatless (sealing) valve. Open position.

WE TURNED A TRAC

to make the feeder that



WHEN CATERPILLAR TRACTOR CO., Peoria, Ill., recently installed two* Perfect Spread Stokers at its Joliet plant it had a very special reason for confidence. The same high traction principle that has been basic to Caterpillar's own success and leadership is employed in the AE conveyor feeder . . . and this principle assures 100% uniformity of spread; *absolutely prevents clogging on wet coal!*

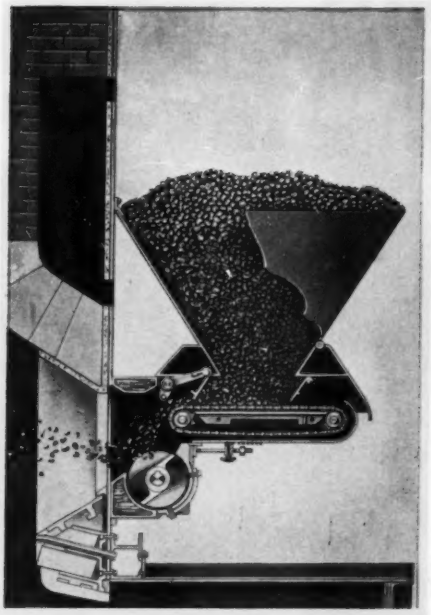
You can get Perfect Spread Stokers in a wide choice of sizes, capacities and grate types . . . but when it comes to the feeder there is only *one* choice. Every Perfect Spread Stoker is equipped with American Engineering's exclusive conveyor feeder . . . the feeder whose superiority is universally recognized and which assures true, *continuous* feeding whether operating at only 50 lbs. of coal per hour or at top capacity.

For most steam per fuel dollar, mail coupon on next page . . . today!

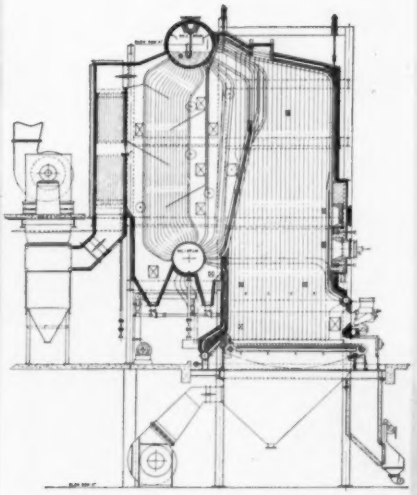
***A THIRD UNIT HAS BEEN ORDERED AND IS NOW BEING ENGINEERED.**

TOR UPSIDE DOWN

won't clog on wet coal



On Perfect Spread Stoker's traveling conveyor feeder a special mechanism drives feeder through a widely adjustable speed range – smoothly and continuously . . . Feeder unit protected against furnace temperatures by water and air cooling around furnace opening and rotor bearings . . . Special high-capacity spiral overthrow rotor distributes coal evenly over the entire grate surface . . . AE reinjection system features visible feed ejector hoppers, ejectors and nozzles of alloy iron. Complete reinjection unit serves every cinder drain point.



Steam generators by Springfield.
Engineering by Giffels & Vallet, Inc.

Cross section drawing showing arrangement of boiler components and some of the principal auxiliaries of the Perfect Spread Stoker installations at the Joliet plant of Caterpillar Tractor Co. The two boilers are designed to operate at 80,000 lbs. per hour continuously, with a peak rating of 90,000 lbs. per hour for a two-hour period. Stokers are 12' wide by 14' 3" long, center to center sprockets. Each stoker has three feeders; 171 sq. ft. total grate area with 150 sq. ft. active area; and each is operated by a 1½ hp. 1800 r.p.m. electric motor.

AE

AMERICAN ENGINEERING
COMPANY
PHILADELPHIA 25, PENNA.

AE Products are: Taylor and Perfect Spread Stokers, Marine Deck Auxiliaries, Hele-Shaw and Hydramite Fluid Power, Lo-Hed Hoists, Lo-Hed Car Pullers.

American Engineering Company
2408 Aramingo Ave., Philadelphia, Penna.

Gentlemen: – We are interested in getting top efficiency from both low and high ash coals. Please send us full information about Perfect Spread Stokers.

☐ Also send us complete story of *Caterpillar Installation.*

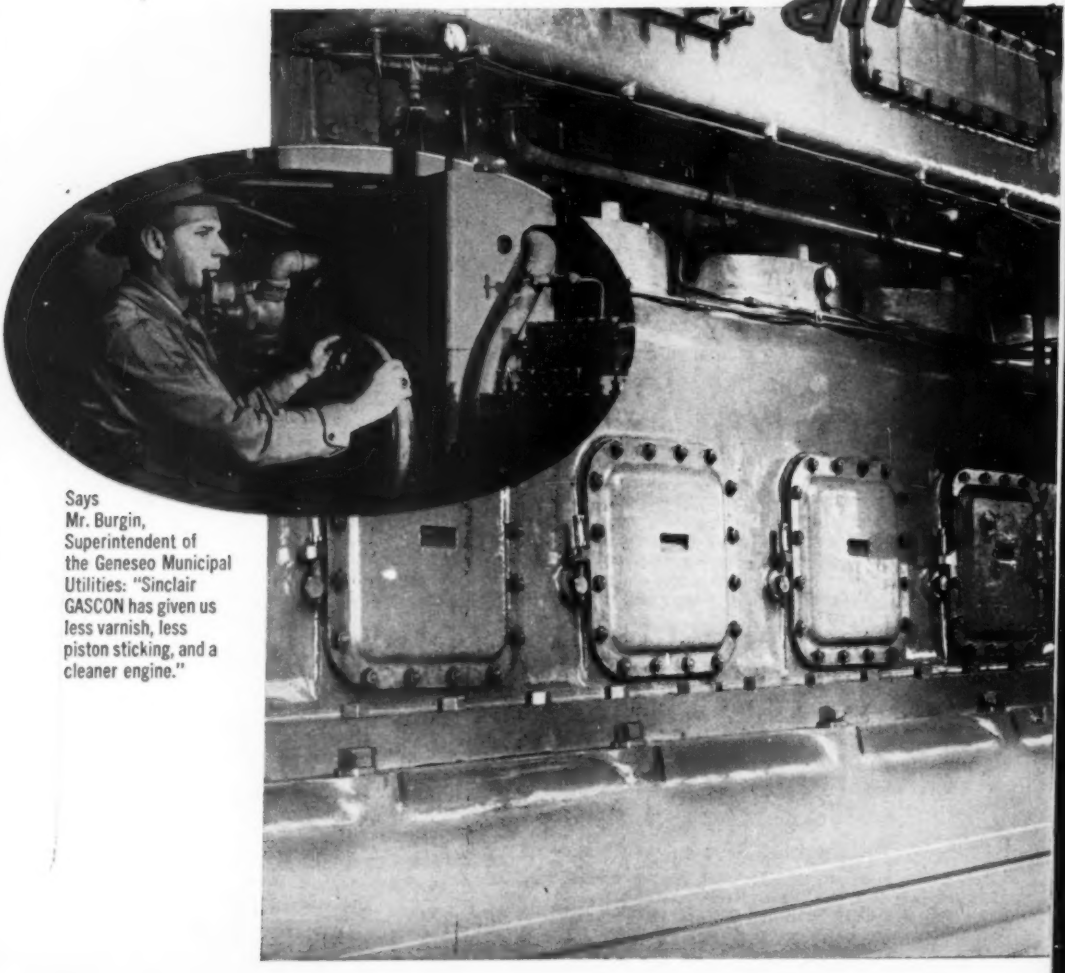
Name..... Title.....

Company .....

Address .....

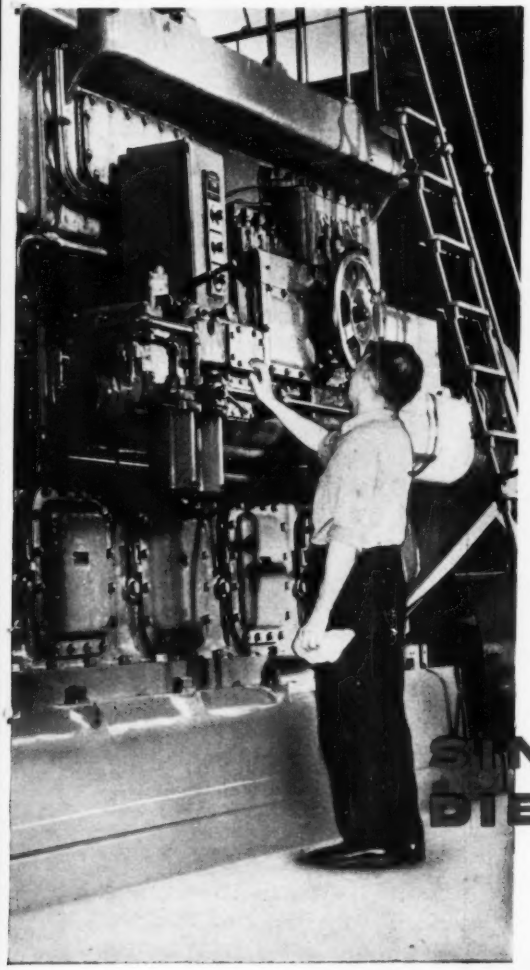
City ..... Zone..... State.....

Light Plant Solves of Sticking and



Says Mr. Burgin, Superintendent of the Geneseo Municipal Utilities: "Sinclair GASCON has given us less varnish, less piston sticking, and a cleaner engine."

Problems Rings Carbon Build-Up!



For quite some time the Light Plant of Geneseo Municipal Utilities, Geneseo, Ill., had trouble with sticking rings, and with carbon deposits in the exhaust ports of its diesels. A few years ago these diesels were changed over to Sinclair GASCON D. Almost at once, it was noted that the troublesome conditions started to clear up. In the time since, sticking rings have become the rare exception and the carbon deposits are no longer a problem.

Furthermore, in 1947, a 1400 hp. Fairbanks-Morse engine, shown at left, was installed and filled with GASCON D. This engine has never had a sticking ring and is running remarkably clean, with exceptionally low cylinder wear.

Perhaps GASCON® Oil can cure *your* diesel troubles, too. Get in touch with your nearest Sinclair Representative or write Sinclair Refining Company, 600 Fifth Ave., New York 20, N. Y.

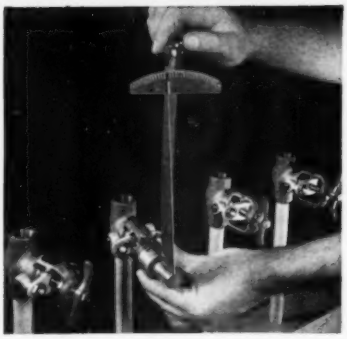
SINCLAIR DIESEL OILS

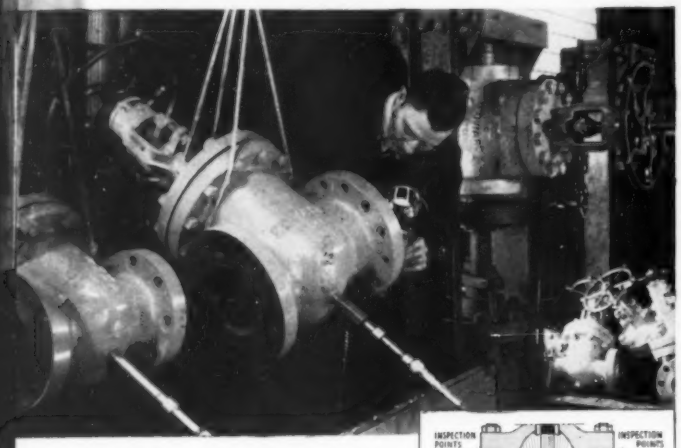
prolong engine life

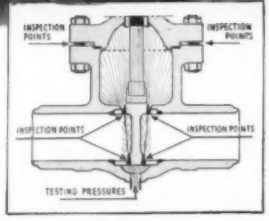
valve values
PHOTO NEWS

No Exceptions- *Every* *Edward Valve* MULTIPLE TESTED

Building components accurately doesn't necessarily insure assembled product performance. Valve tightness, for example, can be established only through rugged testing. And one test isn't enough. Tightness dependability is guaranteed only by multiple testing of every valve—each test designed to prove performance under service operating conditions. For example, the 14-in. PRESSURE-SEAL globe valve (right) designed for operation at 900 psi underwent three separate hydrostatic tests for soundness of pressure containing parts and tightness of bonnet joint and backseat. The Fig. 444 globe valves above, designed for 600 lb, were subjected to a 26 step test procedure including hydrostatic pressure of 3000 psi before receiving an O.K. for shipping release. Every Edward valve from tiny ⅜ in. gage valves to largest 2500 lb design must fully meet test requirements. There are no exceptions or tolerances in Edward testing standards.







Many test procedures are exclusive with Edward. Special method of testing gate valve illustrated uses pressure injected through bottom of body to surround seat faces, yet leaves both ends open for inspection. *Both* sides of gate valve wedge must be tight simultaneously to pass test.

No guesstimating in Edward test procedures. Every test condition is controlled by precision tools and instruments. In applying load to handwheels for seat joint testing, torque wrenches are used to precisely measure allowable test torques—only 70 inch-lb to hold 6000 psi for the Fig. 952 valves pictured. Valves must be drop tight at this load to pass test.

Edward Valves, Inc. Another Product

NEW Forged Instrument Valves

FOR HIGHER TEMPERATURES AND PRESSURES

Modern instruments and controls, operating at high temperatures and pressures, require a large cash investment. Sound operating practice demands that these costly devices be protected by small stop valves designed for use at the temperatures and pressures of the fluid being measured or controlled.

Until recently there was no really satisfactory valve for this service. Small threaded bonnet valves were unsatisfactory for high temperature-pressure applications, but were often used because of the lack of a suitable bonnetless valve. Standard globe valves, satisfactory from an operating standpoint, were too bulky for crowded locations such as instrument panels.

For these services, Edward developed its Fig. 952 series instrument valves. Rated for pressures up to 6000 lb at 100 F or for 1500 lb at 1000 F, these all drop-forged steel O. S. & Y. valves completely answer the need for a high pressure, high temperature instrument valve. They are ideal for installations where space is at a premium.

It is impossible to manually damage these ruggedly constructed little valves. Yoke, gland and gland bolts are drop-forged steel for added strength. Drop-forged body eliminates the possibility of pipe seams often found in barstock construction, or internal voids prevalent in thin-walled castings. The vital body-yoke threaded connection, consisting of an external thread on body and internal thread on yoke, is completely outside of pressure area within valve.

FOR EASY PACKING

Simply remove nuts on the two swing gland bolts and position gland on yoke gland rests. Repack valves, as illustrated, with complete freedom of both hands. Generous space between stem and yoke allows quick, trouble-free repacking.

Stem of hardened EValloy, 13% chromium stainless steel, is centerless ground for smooth packing contact. Tapered, needle point disk integral with stem, plus fine pitch stem thread, allow accurate flow adjustment.

Valves are furnished in ¼", ¾", and ½" sizes in either globe or angle types. Fig. 952-3 valves have carbon steel bodies, while Fig. 2952-3 are furnished with bodies of EValloy, 13% chromium stainless steel. (AISI Type 416 weldable.) Fig. 2952 valves are also furnished in ¾" and 1" sizes. Screwed or socket welding ends are provided.

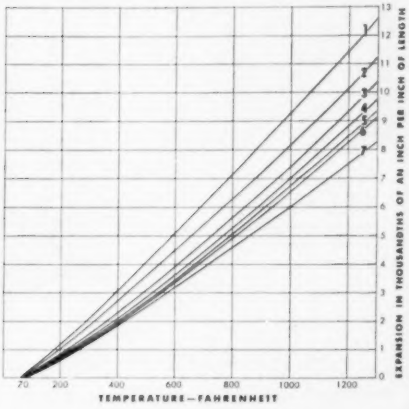
EDWARD VALVES, Inc., *Subsidiary of*
ROCKWELL MANUFACTURING COMPANY
220 W. 144th STREET • EAST CHICAGO, INDIANA

GLOBE AND ANGLE STOP • FEED-LINE • BLOW-OFF • NON-RETURN CHECK • GATE • GAGE AND INSTRUMENT • RELIEF • STRAINERS

Technical Tips

What Thermal Expansion Does to Valve Materials

Coefficients of thermal expansion greatly influence the selection of modern valve materials. For example, if the thermal expansion coefficient of a valve stem is greater than that of the valve body, a valve closed tight at an elevated temperature might be less tight as it cooled off, often resulting in leakage. If, on the other hand, the thermal expansion rate of the stem material is substantially less than that of the body material, the stem will contract less than the valve body on cooling, with the result that it may not be possible to open the valve with ease. Ideally, stem material should have a coefficient of thermal expansion only 10 to 20% less than that of the body and bonnet material.



COEFFICIENT OF THERMAL EXPANSION AT TEMPERATURE OF VARIOUS VALVE MATERIALS

1. 18% Chromium—8% Nickel Stainless Steel valve trim material.
2. Monel—Valve trim material.
3. Stellite No. 6—Valve trim material.
4. A.S.T.M. A216—WCB—Carbon Steel body material.
5. A.S.T.M. A217—WC6—1% Chromium Steel body material.
6. A.S.T.M. A217—WC9—2½% Chromium Steel body material.
7. Edward EValloy—13% Chromium valve trim material.

The chart shows the coefficient of thermal expansion of several valve trim and body materials at temperatures up to 1300 F. Obviously, Edward EValloy meets the ideal thermal requirements for stem materials mentioned above. This, plus its many other desirable properties, make it the most widely used valve stem material.

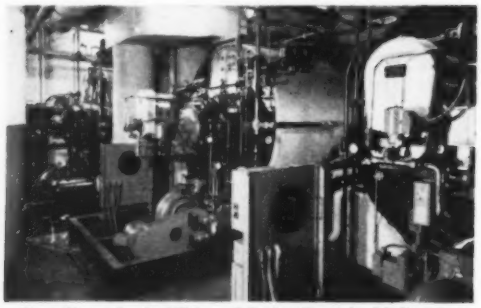
Hard surfacing is an effective method of imparting resistance to abrasion, galling and corrosion to vital parts of valves. However, cracking may occur if the thermal expansion of the deposited metal and the base metal are different. The chart shows that the coefficient of thermal expansion of Stellite No. 6 is very similar to that of the low alloy valve steels on which it is deposited. This, plus its "red" hardness and resistance to abrasion and corrosion at elevated temperatures makes it an excellent hard surfacing material for valves.

Edward

In this modern newspaper building passersby can see running presses through 11 ft. plate glass windows, located directly behind flag pole in this picture.

WASHINGTON POST BUILDING, Washington, D. C. Albert Kahn Associated Architects and Engineers, Inc. John McShain, Inc. — General Contractor. Standard Engineering Company, Engineers and Contractors.

THE WASHINGTON POST'S new 7-story building is heated by a combination of a hot blast ventilating system for the inside areas and convector radiation along the outside walls. The steam distribution system is divided into two sections, one supplying the fan blast coils at 3 lbs. to 5 lbs. pressure and one supplying the radiation at 3 lbs. to 5 lbs. pressure.



Three Cleaver-Brooks 150 hp., oil-fired, self-contained boilers were easily and quickly installed in low headroom, basement space.

Three Cleaver-Brooks 150 hp. oil-fired, self-contained boilers, installed in the basement location, supply steam for the entire heating system.

Modern Cleaver-Brooks boilers are increasingly specified for heating service. Completely self-contained and compact in design, requiring minimum headroom and floor area, Cleaver-Brooks boilers offer many installation and operating advantages — oil, gas, or combination oil and gas firing — fully automatic — clean — dependable performance — operate at a guaranteed efficiency of 80%. Available in sizes from 15 to 500 hp., 15 to 250 psi.

Write for the latest, fully illustrated Steam Boiler Catalog — Cleaver-Brooks Company, Dept. L, 310 East Keefe Avenue, Milwaukee 12, Wisconsin, U.S.A. *Cable address*: CLEBRO-Milwaukeewis.

Cleaver-Brooks
Originators of Self-Contained
STEAM BOILERS

Oil and Bitumen Tank-Car Heaters • Distillation Equipment • Oil and Gas-Fired Conversion Burners

Remember the trade marks "tt" and "TUBE-TURN" are applicable only to products of TUBE TURNS, INC.

Engineered to save maintenance manhours

Scrappy says, "Aid defense—more scrap today... more steel tomorrow."

Write Dept. C-10 for free booklet giving Dimensional Data on types, sizes and materials of TUBE-TURN Welding Fittings and Flanges.

THIS TUBE-TURN WELDING ELBOW is engineered for shape, size, dimension, and wall thickness . . . to provide you with permanent, leakproof piping. It is forged by the only process that produces a wall as uniform in thickness and true in circularity as the original seamless pipe . . . guaranteeing accurate fit-up and *full strength throughout.*

More than ever, any piping installation you make should be maintenance-free, and have extra long life . . . that's why it pays to *specify* TUBE-TURN Welding Fittings and Flanges. For good service call on your nearby TUBE TURNS' Distributor . . . you'll find one in every principal city.

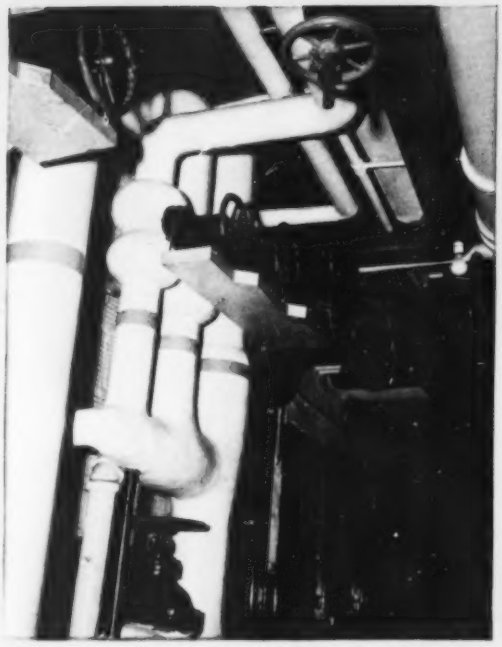
Be sure you see the double "tt"

TUBE TURNS, INC. LOUISVILLE 1, KENTUCKY

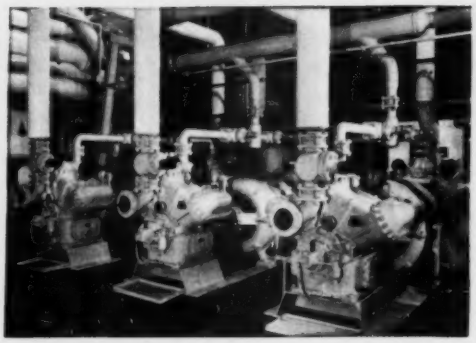
DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Chicago • Houston • Tulsa • San Francisco • Los Angeles

TUBE TURNS OF CANADA LIMITED, CHATHAM, ONTARIO... A wholly owned subsidiary of TUBE TURNS, INC.

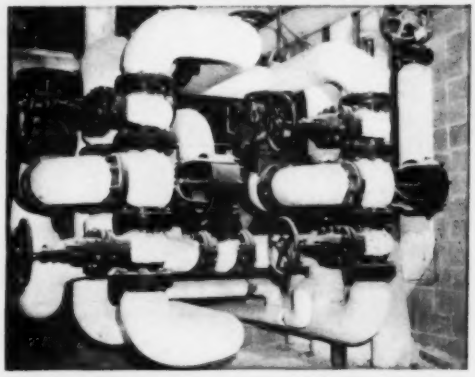
Large buildings cut maintenance with welded piping ...using TUBE-TURN Welding Fittings



FAMOUS HOTEL—New York's Waldorf Astoria uses 160,000,000 pounds of steam annually . . . and has the most extensive air conditioning system in the world. For top efficiency, all main lines, such as this piping to a steam header, are welded. Directional changes are made with **TUBE-TURN** Welding Fittings. All necessary types of welding fittings for any job, large or small, can be obtained from **TUBE TURNS, INC.** . . . which offers the world's broadest line of welding fittings and flanges, in a wide range of types, sizes, and more than 40 different alloys.



DEPARTMENT STORE—Long known for progressiveness in the retail field, the Lazarus Company was one of the first to air condition its selling areas. Facilities have since been extended to all 32 acres of floor space. To keep maintenance to a minimum, an all-welded piping system, using reliable **TUBE-TURN** Welding Fittings and Flanges, was specified for refrigeration equipment, condensers, pumps, etc. Thus joints are permanently leakproof, and insulation is on for life.



HOSPITAL—All piping from 2" up, for new addition to Mount Carmel Hospital in Columbus, Ohio, is welded, with **TUBE-TURN** Welding Fittings specified throughout. In this maze of steam piping to a hot water converter, welded piping fits neatly into a small space. With no flanges to work around, insulation was applied easily. This leakproof piping system eliminates the danger of interruption of vital services.

TUBE TURNS, INC., Dept. C-10
224 East Broadway, Louisville 1, Kentucky

Your Name .....

Position .....

Company .....

Nature of Business .....

Address .....

City ..... *State* .....

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Chicago	Los Angeles

"tt" *and* "TUBE-TURN" *Reg. U. S. Pat. Off.*

TUBE TURNS, INC.

LOUISVILLE 1, KENTUCKY

For its
Contra Costa plant

PACIFIC GAS AND ELECTRIC COMPANY

uses a

GRAVER

Hot Process Softener

This utility, like many others in every section of the country, uses a Graver Hot Process Softener for treating the feedwater to high-pressure boilers.

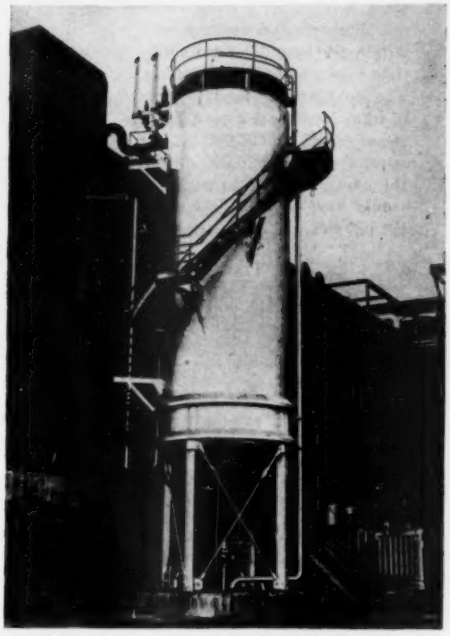
The wide popularity of these Graver units is due to many important advantages.

FOR EXAMPLE:

- **smaller diameter tank for lowest upward settling rate, with resulting economies in cost of tank and installation.**
- **greatest clear settling height, which, together with the low upward settling rate, assures thorough clarification of the treated water.**
- **dual automatic desludging system which protects the boilers from carryover of sludge upon rapid increase in load.**
- **lime feeding system which minimizes deposits in chemical lines.**

In service, Graver Hot Process Softeners reduce both total hardness and silica to the exceedingly small amounts allowable for high-pressure boilers; and clarity of effluent is maintained in many installations *without requiring filters.*

You, too, can depend upon Graver for effective and economical water conditioning. Be sure to consult Graver on your water problem.



Installation of Graver Type S Hot Process Softener for pre-evaporator treatment of 125,000 pounds per hour of feedwater to 1400 psig boilers at the Contra Costa Station of Pacific Gas & Electric Co. in California.

Visit our Booth 541-542, at the Power Show, New York, December 1–6, 1952

GRAVER

GRAVER WATER CONDITIONING CO.

Division of Graver Tank & Mfg. Co., Inc.

DEPT. PE-HP, 216 WEST 14th STREET, NEW YORK 11, N. Y.

In Canada: The Bird-Archer Co., Ltd.; Cobourg, Ontario

In Mexico: Proveedores Tecnicos, S.A.; Puebla 259, Mexico 7, D. F.

GW 459

"WE SAVE $9,000 A YEAR—

"NEW COAL INSTALLATION SAVES US 31.9%—43¢—ON EVERY THOUSAND POUNDS OF STEAM!"

says Mr. Robert W. Paul, Heating Engineer, the University of Akron, Akron, Ohio.

This architect's drawing shows the University of Akron's new steam plant. It is located in a residential neighborhood and operates well within the bounds of extremely tight smoke and dust regulations. The plant burns about 1,450 tons of *bituminous* coal a year, has a steam capacity of 28,000 lbs. per hour. For about $26,000 a year, this new plant does the work that would have cost $35,000 under the old one.

Planning to modernize? Building a new plant? In either case an up-to-date coal installation can save you lots of money!

Labor costs are cut to a minimum with modern coal- and ash-handling systems. And modern combustion equipment gives you more steam for every dollar—10 to 40% more power from every ton of coal!

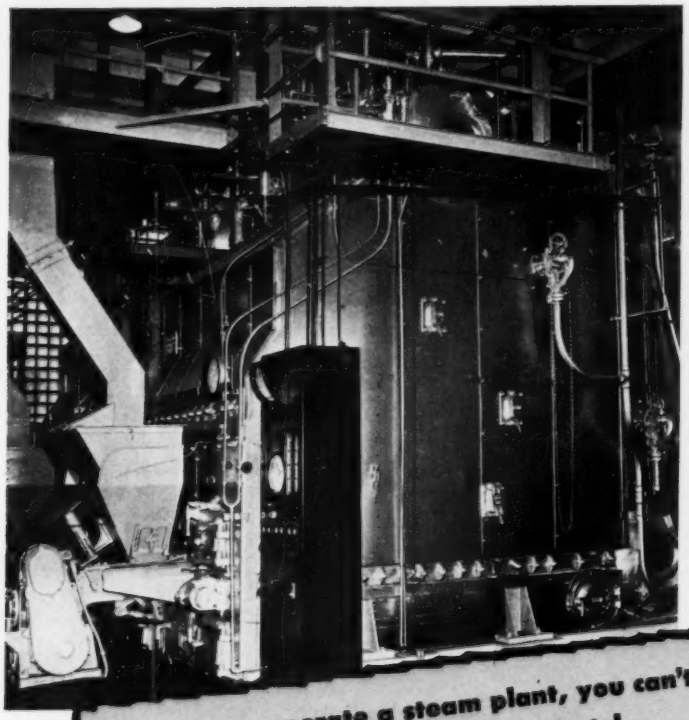
A consulting engineer can show you how these savings really mount up—and mount up fast—when you burn coal in a modern plant designed to meet your *specific* needs.

And coal's your best bet for the future, too. Of all fuels, coal alone has virtually unlimited reserves. And America's coal is mined by the most productive and efficient coal industry in the world. That's why coal offers greater price stability and more dependable supply than any other fuel!

BITUMINOUS COAL INSTITUTE
A DEPARTMENT OF NATIONAL COAL ASSOCIATION
WASHINGTON, D. C.

FOR HIGH EFFICIENCY FOR LOW COST

AND HEAT MORE SPACE—BY BURNING COAL THE MODERN WAY!"



NO SMOKE CONDITION... NO DUST NUISANCE— THANKS TO BURNING AND HANDLING COAL WITH UP-TO-DATE EQUIPMENT!

This view shows Akron's two new stoker-fired boilers. Coal is delivered by truck through a hopper and into a dust-tight room. Ashes are removed pneumatically. The old equipment delivered a thousand pounds of steam at a cost of $1.35. This new installation has cut this cost nearly ⅓. Now Akron gets a thousand pounds of steam for only 92 cents!

If you operate a steam plant, you can't afford to ignore these facts!

COAL in most places is today's lowest-cost fuel.

COAL resources in America are adequate for all needs—for hundreds of years to come.

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

YOU CAN COUNT ON COAL!

This is *PRECISION*

A-C Crane Hoist Control

15 Tons of Steel . . . handled as though it weighed a pound. The picture at the right tells the story. A walnut and wrist watch were placed side by side. The operator lowered the 15-ton, full-hook load. The walnut was cracked. Then the load was raised without the least settling action. The watch was left untouched.

That's Precision . . . precision that is attained on all cranes equipped with the new Westinghouse Load-O-Matic Crane Control. In this particular test, the load was lowered with the master switch set at the first point lower. No jogging, inching or retardation was necessary—lowering rate was smooth and steady.

The Load-O-Matic hoists and lowers *all* loads—the empty hook, light or maximum loads—at stabilized speeds. Loads can be brought to a standstill or suspended by action of the motor only.

VERNIER CONTROL PROVIDES FLEXIBILITY

Additional flexibility of operation is available with the auxiliary Vernier control. This control component is especially useful for high-accuracy spotting. For example—with full load on the hook and the master switch on the first lowering point, operation of the Vernier provides control from approximately 7% of full speed to standstill. Operator can actually float the load into the desired spot.

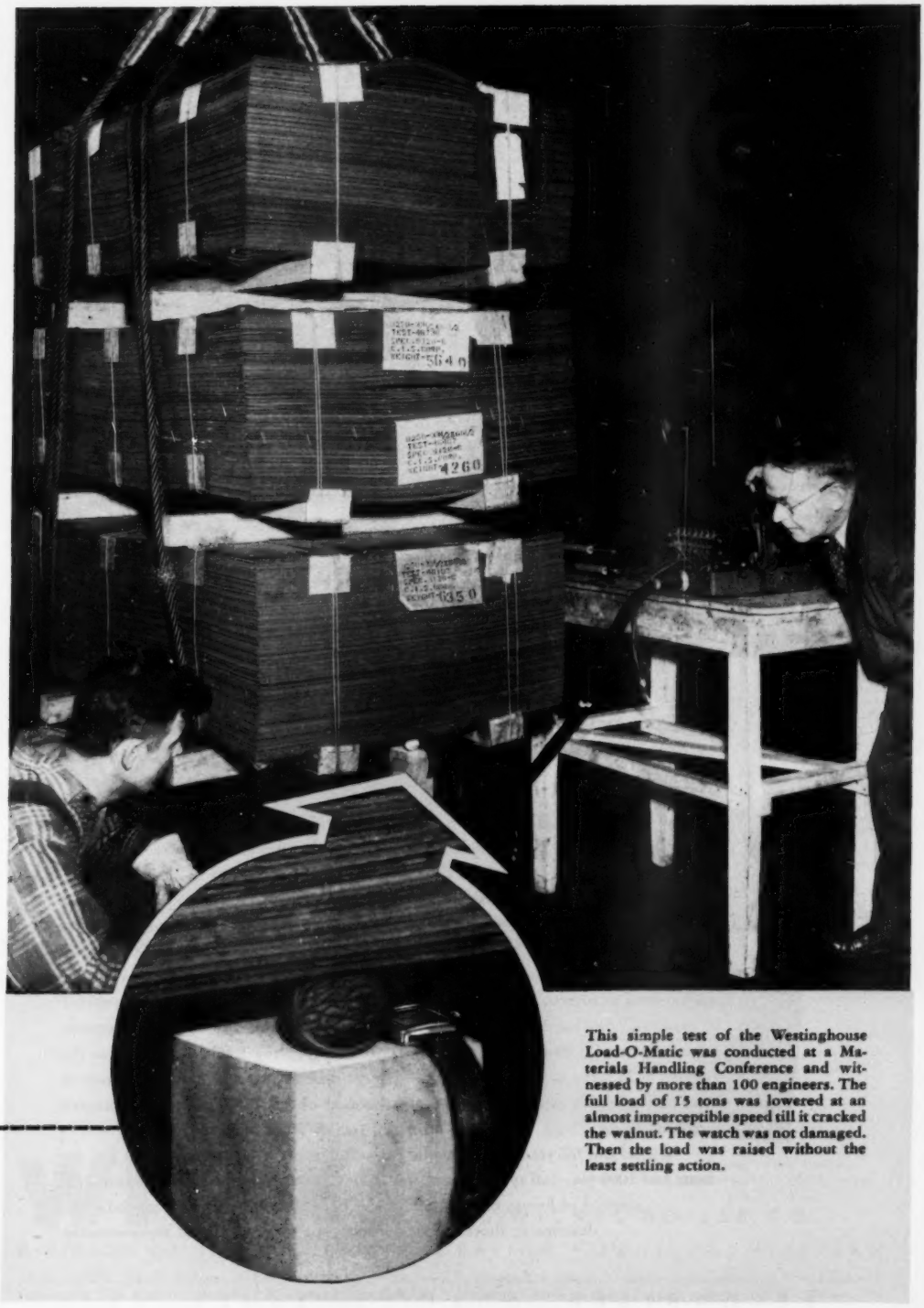
ASK FOR DESCRIPTIVE BOOKLET B-5417

This booklet describes all the operating characteristics and features of the Load-O-Matic a-c crane hoist control. Ask your Westinghouse representative for your free copy, or write direct to: Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-27015

YOU CAN BE **SURE**...IF IT'S

Westinghouse

CRANE CONTROLS



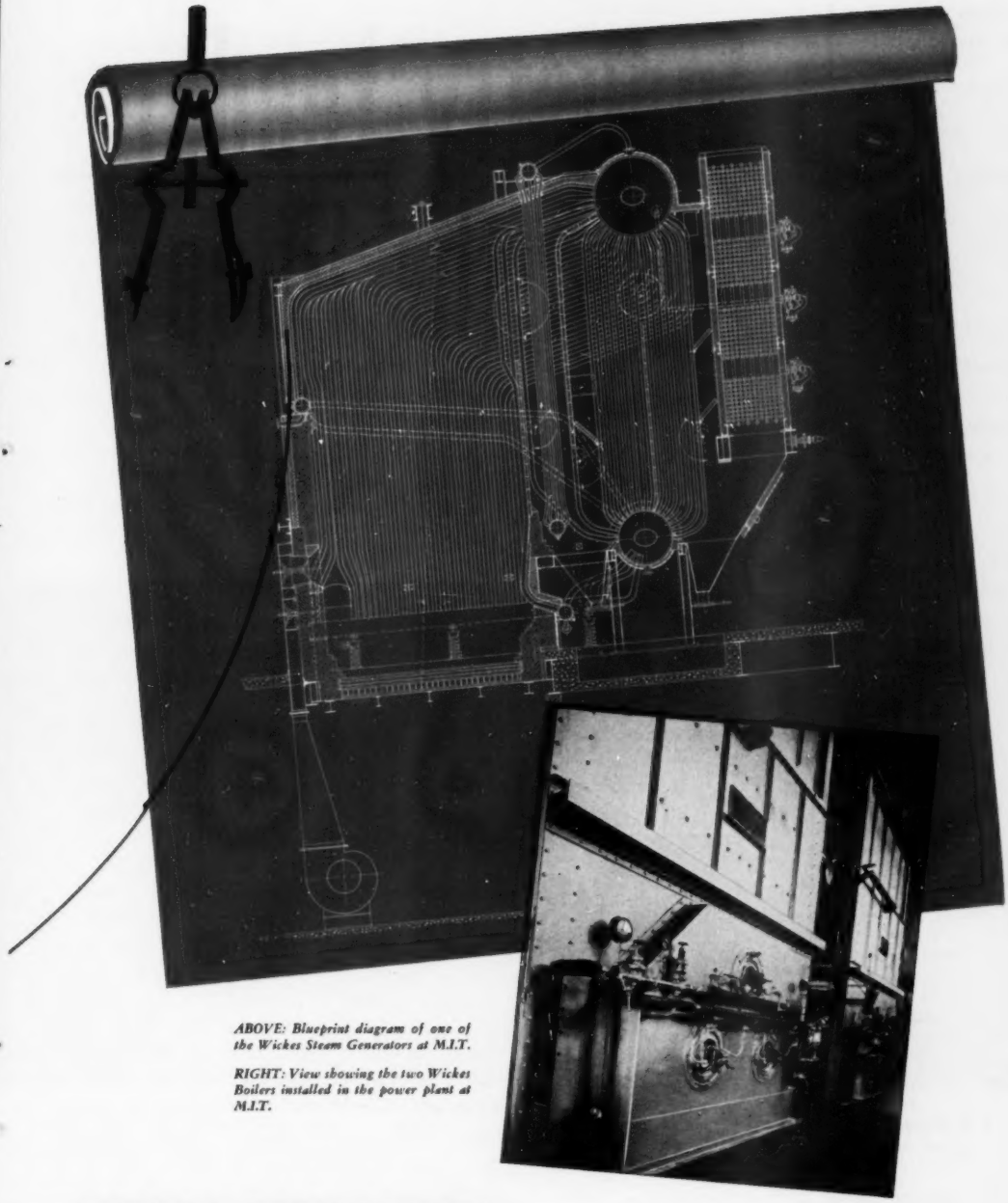
This simple test of the Westinghouse Load-O-Matic was conducted at a Materials Handling Conference and witnessed by more than 100 engineers. The full load of 15 tons was lowered at an almost imperceptible speed till it cracked the walnut. The watch was not damaged. Then the load was raised without the least settling action.

M.I.T., famous engineering school, uses WICKES boilers for steam production

Consultants — JACKSON & MORELAND, ENGINEERS of Boston, Mass.

AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY, where sound engineering principles are taught, two Wickes Steam Generators were selected to supply heat for several new buildings including the Hayden Library and Sloan Metals Research Laboratory. The Wickes Boilers, which were custom-engineered for M.I.T., produce 160,000 lbs., of steam per hour. They occupy the same space formerly occupied by the two old boilers that produced only 40,000 lbs. per hour. They are equipped with superheaters and economizers. The new boilers are oil-fired at present but are engineered for ready conversion to spreader stoker if desired. They are designed for quick steaming to meet emergency power requirements and are fitted with thermowells and openings for taking flue gas samples so the students at M.I.T. can run boiler tests as part of their instruction. The installation of these boilers, an extremely difficult job because of the close erection tolerances, was handled by Flagg, Brackett & Durgin, Inc., Wickes' agents in Boston. ✓ ✓ ✓ Wickes can fill your requirements for steam generators up to 250,000 lbs. per hour and 1000 psi.—all types of multiple drum boilers adaptable to any standard method of firing; oil, gas, underfeed or spreader stoker. Write today for descriptive literature or consult your nearest Wickes representative.

RECOGNIZED QUALITY SINCE 1854



ABOVE: Blueprint diagram of one of the Wickes Steam Generators at M.I.T.

RIGHT: View showing the two Wickes Boilers installed in the power plant at M.I.T.

WICKES

142

THE WICKES BOILER CO.

DIVISION OF THE WICKES CORPORATION • SAGINAW, MICHIGAN

SALES OFFICES: Atlanta • Boston • Buffalo • Chicago • Cincinnati • Cleveland • Denver • Detroit • Greensboro, N.C. • Houston • Indianapolis • Los Angeles • Memphis • Milwaukee • New York City • Pittsburgh • Portland, Ore. • Saginaw • Springfield, Ill. • Tampa, Fla. • Tulsa • Washington, D.C.

Industries served by VU Boilers

- Aircraft
- Asphalt
- Automobile
- Breweries
- Building Materials
- Carpet
- Cellophane
- Cement
- Chemical
- Coal Mining
- Coke
- Cold Storage
- Dairy
- Department Stores
- Distilling
- Explosives
- Electrical Equipment
- Electric Power
- Food Products
- Foundries
- Gas Works
- Gelatine
- Glass
- Hosiery
- Knitting Mills
- Institutions
- Laundries
- Leather
- Linoleum
- Locomotive
- Lumber
- Machinery
- Metal Producing
- Mining
- Municipal
- Oil Refining
- Paint
- Paper
- Public Utilities
- Radio
- Railways
- Refrigeration
- Rubber
- Schools
- Sewage Plants
- Shipbuilding
- Sugar
- Textile
- Tobacco
- U. S. Government

Industry Leaders Set the Pace with VU

Right down the line, in most every industry, you'll find the leading companies — as well as the smaller companies that may well be tomorrow's leaders — depending on C-E Vertical-Unit Boilers for dependable, low-cost steam.

Take Pulp and Paper Mills for example. Few industries use more steam or have a larger stake in the economy and reliability of their steam generating equipment. The list on the opposite page is just a small sample of the nationally-known leaders in the pulp and paper field that have Vertical-Unit Boilers in service at one or more mills.

Only larger companies are listed because here, as in any industry, the buying decisions of big companies are especially significant. Such companies have the breadth of experience, the diversified operating conditions and the organization necessary to explore and evaluate the merits of the equipment they need.

So, where you need boilers — in capacities from 10,000 to 350,000 pounds of steam per hour — take a tip from the leaders. Discover — as they have — the advanced design . . . sound construction . . . proved reliability of C-E Vertical-Unit Boilers.

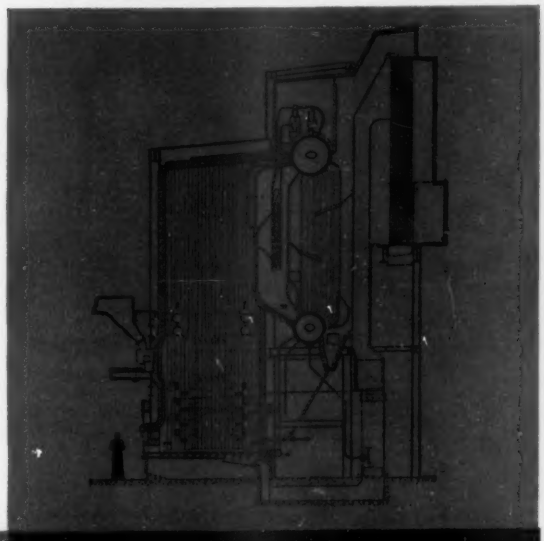
COMBUSTION ENGINEERING

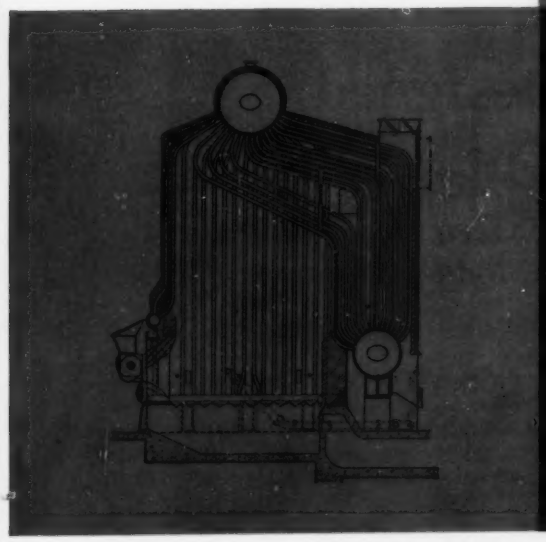
ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

Leading Pulp and Paper Mills that have Purchased VU Units for One or more Plants

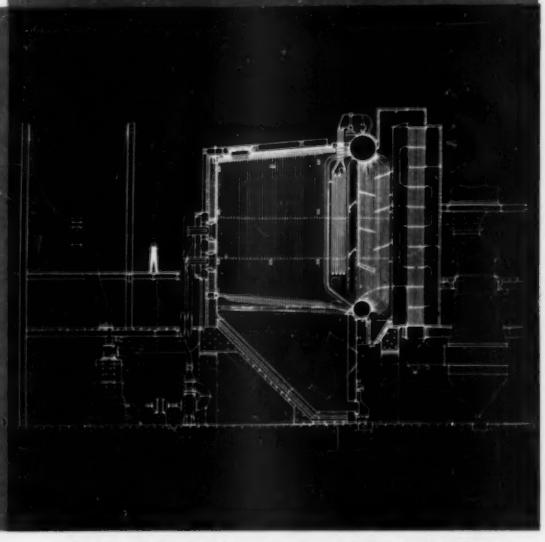
The Brown Company
Chesapeake Corporation
Container Corp. of America
Fraser Companies, Ltd.
Robert Gair Company, Inc.
International Paper Company
Kimberly-Clark Corporation
Macon Kraft Corporation
Marathon Paper Mills of Canada, Ltd.
National Container Corporation
St. Regis Paper Company
Scott Paper Company
S. D. Warren Company
Weyerhauser Timber Company

VU-50 Boiler — This unit, one of two duplicates, is installed at a West Coast mill. It is designed to burn hogged wood on a high-set spreader stoker. Capacity — 150,000 lb of steam per hr; operating pressure — 570 psi; steam temperature 675 F.





VU-10 Boiler, one of two in a Midwestern plant. Fired by coal, using a C-E Spreader Stoker. Capacity — 18,000 lb of steam per hr at 200 psi; no superheat. VU-10 capacities range from 10,000 to 60,000 lb of steam per hr.



VU-50 Boiler installed in a Southern mill. This boiler is fired with pulverized coal using C-E Raymond Bowl Mills. The capacity is 150,000 lb of steam per hr. Steam pressure is 865 psi — steam temperature is 825 F.

D-612

— SUPERHEATER, INC.

200 MADISON AVENUE, NEW YORK 16, N. Y.

C-E

SPECIALLY DESIGNED 500 GPM WORTHINGTON TREATING SYSTEM at the new Pemex natural gas refinery in Poza Rica, Mexico. System includes cold-process slurry-type softener followed by acid feed, filtration and zeolite treatment. Engineered by Arthur G. McKee Company.

Specially Designed for Intermittent Service

Softening system for boiler feed water built for short-period operation, long shutdowns

Water conditioning requirements are especially tough at the new Pemex natural gas refinery in Poza Rica, Mexico.

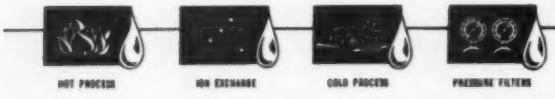
Their need for variable-rate, continuous-service softener operation is complicated by the intermittent boiler feed-water storage demands.

Pemex's conditioning requirements have been met by a specially built Worthington system, so designed that the slurry bed is not lost during "off-service" periods. The bed resumes its normal suspended position at the instant service is resumed. This avoids the irregular treatment, delay and water waste common in systems that require creation of a new slurry bed after each shutdown period.

New Bulletin W-212-B5 gives you the vital facts about this unique cold process water softening method. Write for your free copy today.

Worthington engineers and builds equipment for all the major types of water-conditioning systems, therefore is in an excellent position to give comprehensive and well-balanced recommendations on your water-conditioning equipment problems . . . further proof that *there's more worth in Worthington*. Worthington Corporation, Water Treating Section, Harrison, N. J.

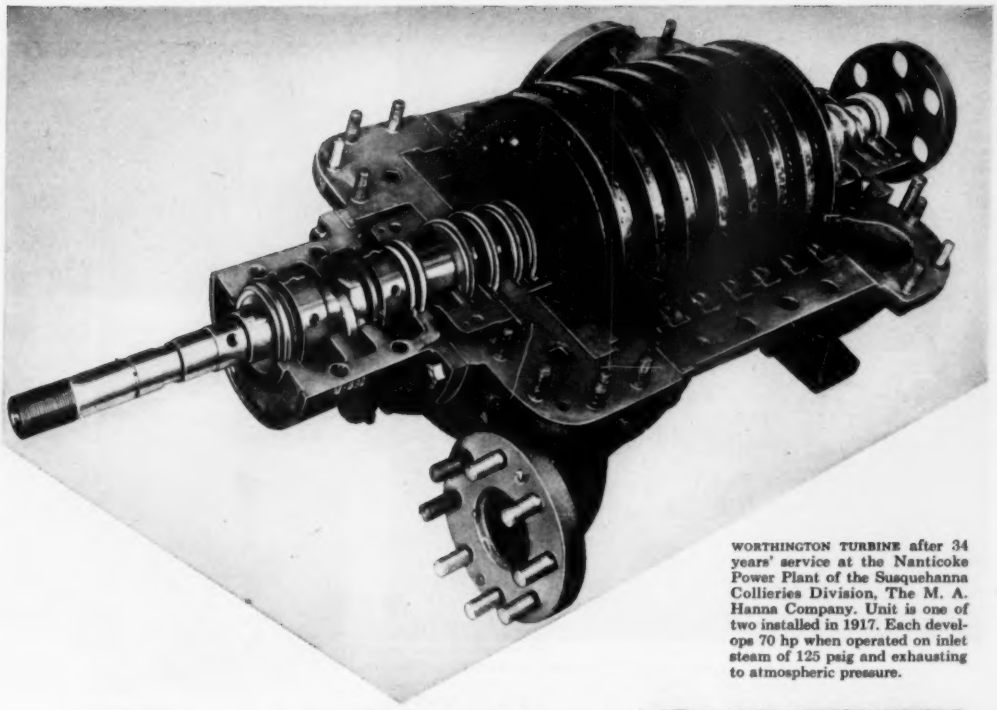
J1.3



Worthington Makes More of the Equipment for ALL Types of Water Conditioning Systems

WORTHINGTON

Water Conditioning



WORTHINGTON TURBINE after 34 years' service at the Nanticoke Power Plant of the Susquehanna Collieries Division, The M. A. Hanna Company. Unit is one of two installed in 1917. Each develops 70 hp when operated on inlet steam of 125 psig and exhausting to atmospheric pressure.

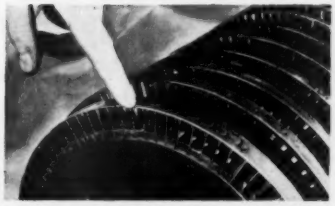
This reconditioned Worthington Turbine has seen 34 years' service

Installed in 1917, this Worthington steam turbine will probably go on to serve the Nanticoke Power Plant of the Susquehanna Collieries Division, The M. A. Hanna Company, for many years to come.

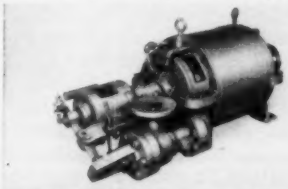
This unit is one of two that for 34 years have been driving induced draft fans—and was recently returned to Worthington's Wellsville, N. Y., plant for reconditioning.

Whether your requirements call for 70 hp or 24,000 hp, the complete Worthington line offers you the right steam turbine for your mechanical drives—a rugged performer that's ready to serve you economically and give you years of uninterrupted service.

Worthington Corporation, Steam Turbine Division, Wellsville, New York.



CLOSE-UP OF TURBINE BLADING shows that, except for a few single insertions, it remains the same as when turbine was installed 34 years ago.



COMPLETE TURBINE—ONE OF THE TWO that have been driving fans for Susquehanna Collieries since 1917.

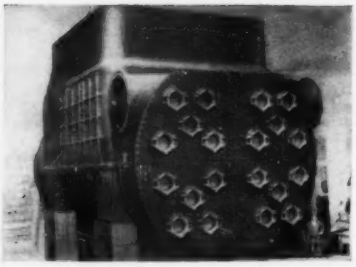
T.2.3

A GREAT TEAM IN STEAM

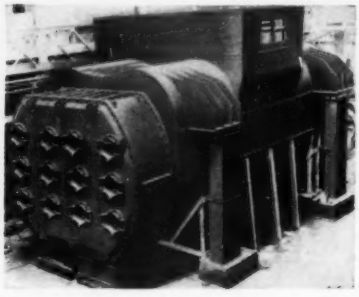
WORTHINGTON

Steam Turbines

CON EDISON'S EAST RIVER ELECTRIC GENERATING STATION at 14th Street, New York City, will contain the new Worthington 125,000 sq-ft condenser. The shell, which is to be installed under 160,000-kw Unit No. 7, will contain nearly 105 miles of ¾" O.D. aluminum brass tubes and will require 138,000 gpm of East River water supplied by two 54 in. Worthington "Mixflo" vertical single suction volute circulating pumps.



WORTHINGTON CONDENSER installed in 1931 to serve 160,000-kw Unit No. 7, Hudson Avenue Station. Tube sheets were drilled for 110,000 sq ft with 101,000 sq ft installed.



ONE OF TWO 74,500 SQ-FT 2-PASS WORTHINGTON CONDENSERS serving 60,000-kw Units 14 and 15 at Waterside Station No. 1.

Con Edison once again installs "largest" condenser

On several occasions over the past fifty years, Worthington has been selected to build the "world's largest" surface condensers in single shell design.

In 1919, a 70,000 sq-ft condenser was installed under a 35,000-kw turbine-generator for a prominent utility company. This was the largest single shell surface condenser of its day.

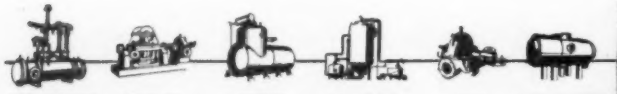
In 1931, Brooklyn Edison Company (now Consolidated Edison Company of New York, Inc.) installed, under 160,000-kw Unit No. 7 at the Hudson Avenue Station, the "world's largest" at that time, a 101,000 sq-ft single-pass Worthington condenser. This was followed, in 1949, by two 74,500 sq-ft condensers for Waterside Station No. 1.

Now, Worthington is again building for Con Edison the "world's largest" single-shell condenser ever ordered, 125,000 sq-ft, single-pass, for the 160,000-kw Unit No. 7 addition to East River Station.

Worthington, with over a century of experience in the manufacture of steam power equipment, is prepared to build efficient condensers in all sizes. Let us advise you, without obligation, on your new installation.

Write, stating requirements, to *Worthington Corporation, Steam Power Division, Harrison, New Jersey.*

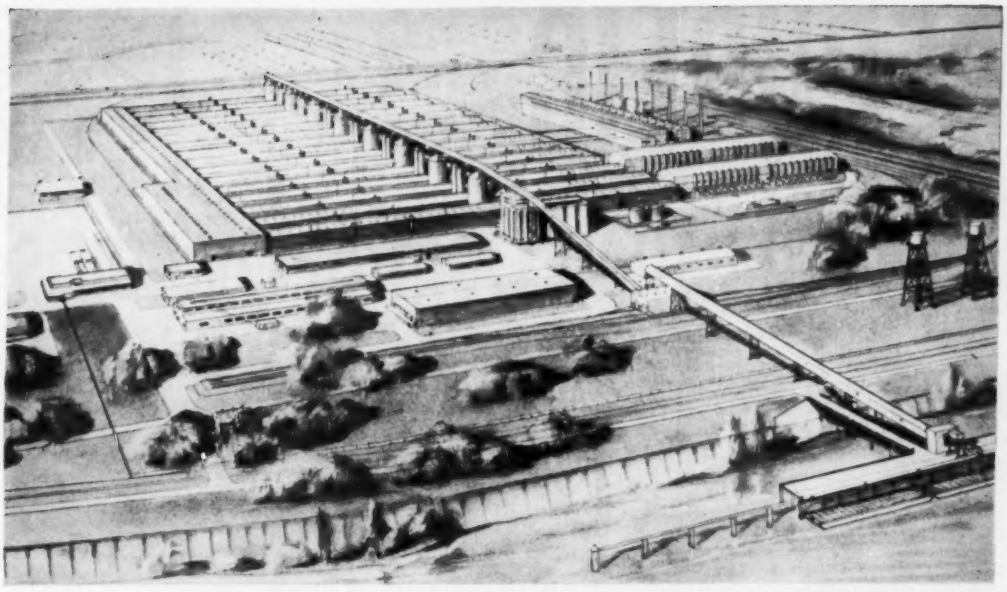
Z.2.2



World's Broadest Line of Steam Power Plant Auxiliaries

WORTHINGTON

Condensers



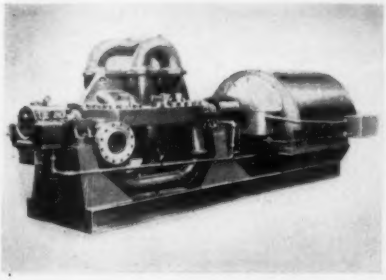
KAISER ALUMINUM AND CHEMICAL CORPORATION'S new 400,000,000 pound-a-year, $150,000,000 aluminum reduction plant at Chalmette, La., designed and built by Kaiser Engineers, is the largest plant of its kind in the U. S. The plant—where production began in December, 1951—uses 19 Worthington boiler-feed pumps and other Worthington equipment including thirty 9,300 square-foot condensers, and fifteen 250,000 pound-per-hour deaerators, 2 steam turbines and numerous circulating pumps.

Power plant at largest aluminum reduction plant to use Worthington pumps, condensers, deaerators

It takes plenty of electric power to produce 400,000,000 pounds of aluminum in a year. And that's what they're doing at the new Kaiser Aluminum plant at Chalmette, La.—largest aluminum reduction plant in the U. S.

Kaiser joins many other top companies in choosing Worthington boiler-feed pumps as well as other key equipment for their new plant. Such choices arise out of an insistence for equipment that's engineered for maximum performance.

Worthington engineering produces boiler-feed pumps of the most advanced design in the field, made from specially selected metals. Each pump is exactly *right* for the pressure and temperature with which it is to perform. Over 110 years of Worthington experience in building pumping equipment go into making this a certainty. Worthington Corporation, formerly Worthington Pump & Machinery Corporation, Centrifugal Pump Division, Harrison, New Jersey. C.2.4

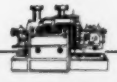


19 WORTHINGTON 250,000 LBS PER HR BOILER-FEED PUMPS at new Kaiser plant, handle feedwater at 257 F against a discharge pressure of 1,030 psig. Pumps are axial-balanced, volute type centrifugals. Two, similar to one illustrated, are driven by Worthington 450-hp steam turbines.

For Boiler Feed Service. Capacities to 1,500 GPM; Heads to 1,000 feet.

For Hotwell, Condensate, Chilled Water Service. Capacities to 1,400 GPM; Heads to 650 feet.

For Water Works, Circulation, Drainage, General Service. Capacities to 135,000 GPM; Heads to 400 feet.



For Boiler Feed Service. Capacities to 3,000 GPM; Heads to 7,000 feet.

The World's Broadest Line Assures You the Right Pump for Every Job

WORTHINGTON

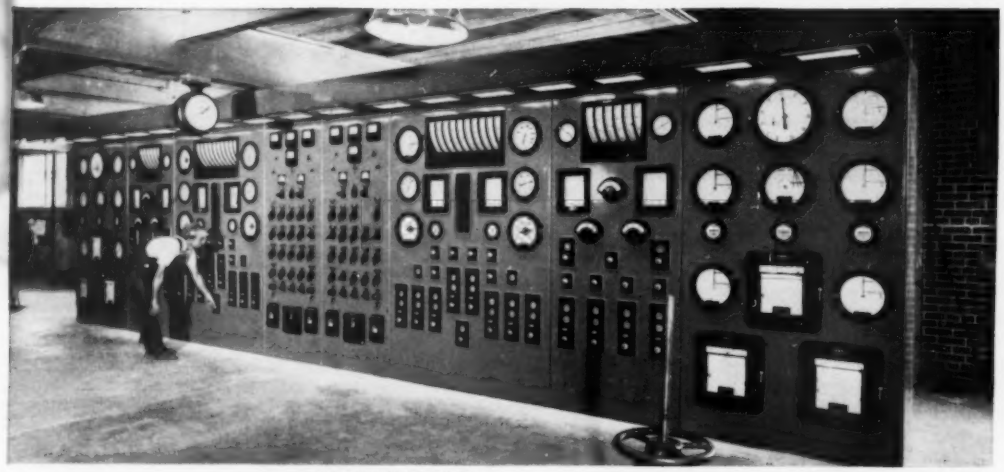
Centrifugal Pumps

REPUBLIC
Combustion Control Systems

AN automatic combustion control system, as designed and built by Republic, will enable you to operate your boiler (or boilers) over a long period at test efficiencies regardless of variations in fuel, load and other operating factors.

Republic combustion control is a unified system controlling the fuel and air supply to the boiler in the correct amount to maintain constant steam pressure and in the correct ratio to maintain maximum combustion efficiency.

Republic automatic combustion control systems, either pneumatic or hydraulic, are available for all sizes of boilers, all types of fuel firing, and load conditions and any arrangement of draft equipment. They are completely described in Data Book No. S-21—write for your copy.

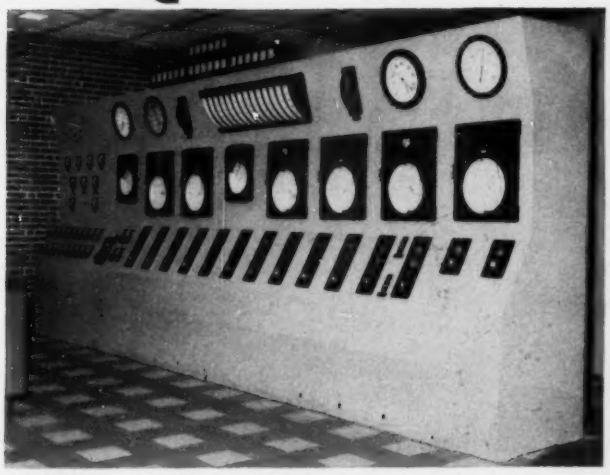


PULVERIZED COAL
In this modern central station steam is generated in two 600,000 lbs. per hr. pulverized coal fired boilers operated by a Republic Combustion Control System.

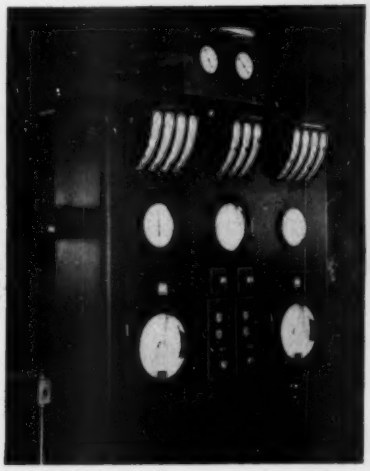
REPUBLIC FLOW METERS CO.
2240 Diversey Parkway, Chicago 47, Illinois

for

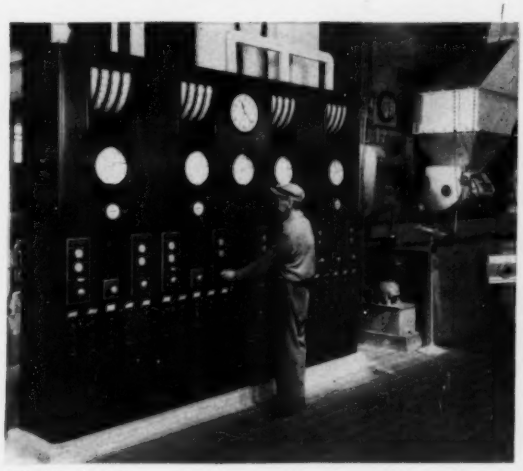
- All Sizes of Boilers
- All Types of Firing
- All Arrangements of Draft
- All Load Conditions



OIL FIRED
A typical Republic automatic boiler control and instrument installation in a large central station for the operation of a 450,000 lb. per hr. oil fired boiler.

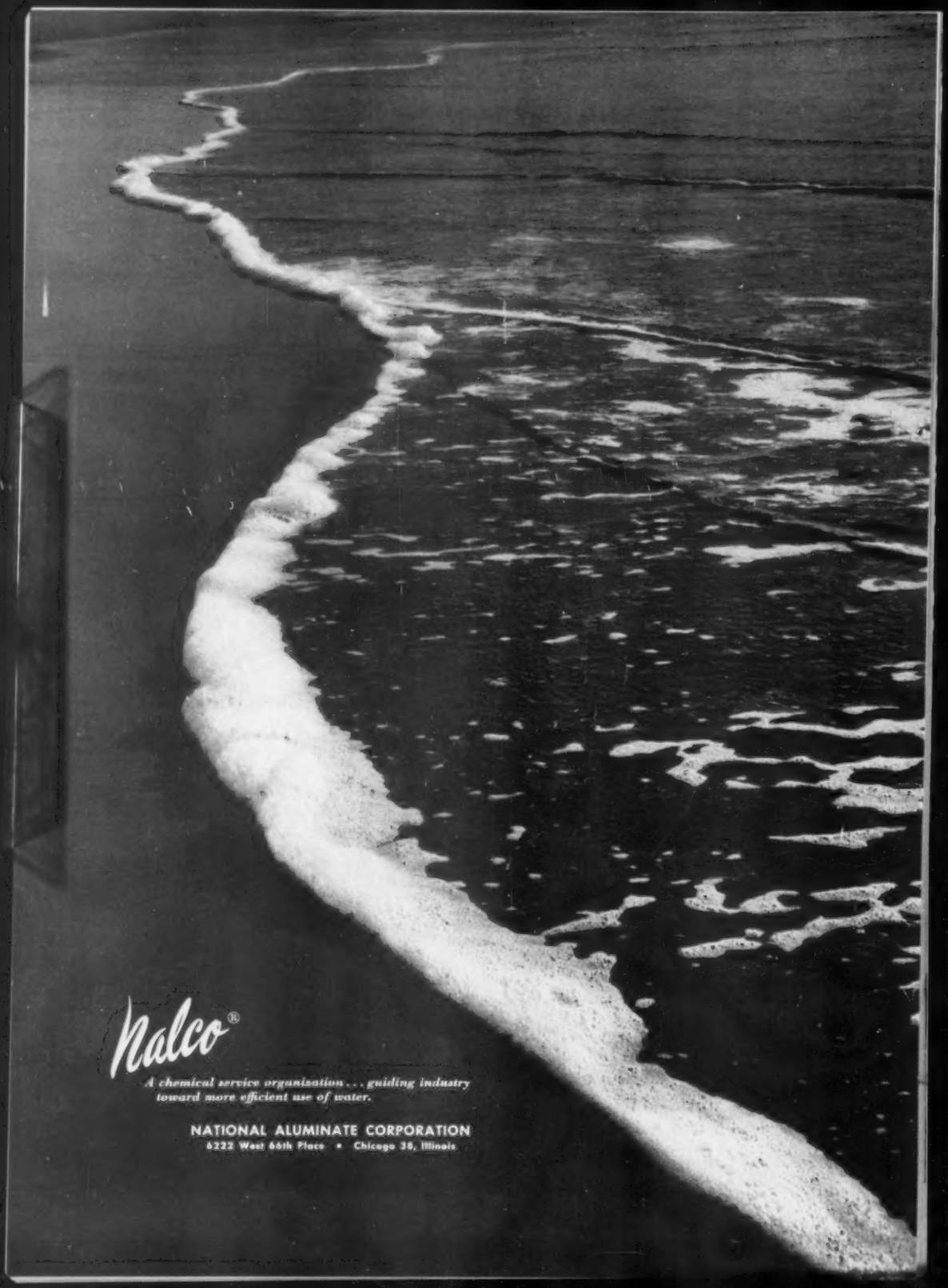


MIXED GAS
Republic instrument and controls for two 50,000 lb. per hr. boilers burning mixed gas.



STOKER FIRED
The Republic combustion control and instrument panel for the automatic operation of four 80,000 lb. per hr. stoker fired boilers.

STOKER FIRED
In this modern industrial plant steam is generated in a 175,000 lb. per hr. stoker fired boiler operated by a Republic control system.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Helpful Bulletins

THE ANSWERS to many of your operating and maintenance problems are found in these new and recently revised catalogs and bulletins. List the paragraph numbers of those you want on the card at bottom of page, detach and mail

ELECTRICAL

101 **Wire, Cable Ordering Guide** — Newly-released General Catalog W-52-3, 186 pp, presents more than 500 different types of wires and cables. Contains comprehensive data on construction and operating characteristics for control and signal cables, cables for construction work, telephone wire and cables, and portable cords. A detailed technical engineering data section is also included. United States Rubber Co.

102 **Breaker Test Data** — Bulletin 71R7855, "How Much Can a Breaker Take?" is an 8-pp article describing results of recent field tests conducted on a standard 69-kv, 1500-mva oil circuit breaker at the Siegfried substation of the Pennsylvania Power and Light Co. Allis-Chalmers Mfg. Co.

103 **Miniature Circuit Breaker** — Miniform 101 introduces a circuit breaker that fits like a fuse in any standard plug-type fuse receptacle. Explains how this breaker gives protection against overloads and shorts for industrial and other buildings, also electrically operated machines and appliances. A keyed cutway illustration shows how the breaker is designed. Mechanical Products, Inc.

104 **Potheads and Terminals** — New Catalog C79-13, about 100 pp, comprises Section 13 of manufacturer's general catalog. Includes complete design data as well as information and instructions for ordering and installing all types up to 46 kv. Features both outdoor and indoor types and designs for transformers, switchgear. Anaconda Wire & Cable Co.

105 **Silicone Electrical Insulation** — Although original AIEE specifications for Class H insulation referred to a rather rigidly confined group of components, subsequent development has produced a wide range of materials and combinations and a variety of Class H insulations, each suited to a different purpose. Illustrated Form G-26 presents a detailed list of recommended Class H components, giving properties, specifications, uses and availability. Of interest to any power engineer concerned with economical performance of electric motors under difficult operating conditions. Dow Corning Corp.

106 **Terminal Manufacture** — Not an ordering catalog, "The Harrisburg Story" is a strikingly different 20-pp brochure describing the origin, growth, and engineering principles of this manufacturer of solderless terminals and fixed capacitors. Aircraft-Marine Products, Inc.

107 **Meet Microwave** — "An Introduction to Microwave," 20 pp, provides a semi-technical description of RCA microwave equipment and is illustrated with photos, charts, diagrams etc. Describes microwave radio, tells how it works, gives propagation characteristics, operational advantages, economic factors influencing choice of frequencies, and desirable design characteristics. Also deals with multiplexing, telemetering and remote control features; tells who can use microwave, how to plan a system. Microwave Communications Section, Radio Corp. of America.

INSTRUMENTS AND CONTROLS

108 **Oil Burner Controls Handbook** — This 48-pp pocket size booklet is generously illustrated and provides excellent information on the use of oil burner controls. Provides control wiring diagrams, installation instructions and service hints. Some 28 types of company's controls are presented in detail and there are comparison charts covering competitive controls. The Mercoid Corp.

109 **For Positioning Control** — Bulletin 157, 12 pp, presents company's HydroTorque designed for accuracy and power in hydraulic positioning and indicating applications. Explains the operation and adaptability of the system, lists ten mechanical advantages. Transmitter and receiver are described, specifications given. Includes thrust and torque capacities. Parris Hydro-Torque Corp.

110 **Bubbler-Type Level Control** — Illustrated Bulletin 1650, 8 pp, describes a bubbler-type liquid level control using either built-in air compressor, existing air supply or a bottle-gas unit. Tells its use in sewage systems, industrial processing, explains how the control operates. Automatic Control Co.

111 **Bin Level Indicator** — The Bin-Vue, a simply designed level indicator for any dry bulk flowable material, is pictured and described as to operation and advantages in this bulletin. Includes dimensions, prices. Convair.

112 **Instrumentation** — for Ike or Adlai — A description of the ultra-modern graphic control panel for the new White House air-conditioning system is featured in the 40-pp Third Quarter 1952 issue of Instrumentation. Also included are an article on Teflon valve packing, and an article on the instrument courses taught at Case Institute of Technology. Industrial Div., Minneapolis-Honeywell Regulator Co.

BOILER TUBING

114 **Welded Steel Tubes** — Data of interest to all power engineers are included in Bulletin TB-881A. In addition to general information, contains tables of maximum allowable working pressures of electric-resistance-welded steel boiler tubes for fire-tube and water-tube boilers and weights per foot for various tubing sizes. Tubular Products Div., The Babcock & Wilcox Co.

115 **To Avoid Tube Corrosion** — Bulletin TR-514 is an 8-pp illustrated article discussing corrosion as a major factor in shortening the life of boiler tubes. Indicates that, in low pressure boilers, corrosion is the largest single cause for replacement of tubes. Points out types and causes of corrosion and gives general rules to follow to get maximum service life from boiler tubing. Tubular Products Div., The Babcock & Wilcox Co.

VALVES, TRAPS AND PIPING ACCESSORIES

116 **New Valve Techniques** — Sixteen-pp Technical Bulletin 106, "New Techniques in Control Valve Design," is described as one of the most comprehensive technical papers published on pneumatic final control elements. Presents a complete review of the development of present day conventional control valves and a look-see into future designs. Well illustrated. Conoflow Corp.

117 **Magnetic Pipeline Traps** — Bulletin B-203 describes magnetic pipeline traps for sanitary and standard applications. These permanent (non-electric) traps are designed to remove tramp iron from liquid flow lines and afford protection to processing equipment. Typical trap installation data presented. Also included are sections on variables affecting trap size, and a classification of products affecting trap capacities in gallons per minute. Eriez Mfg. Co.

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October 1952
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POWER ENGINEERING

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118 **Liquid Strainer** — Application, parts list, working pressures and dimensions of company's Ideal liquid strainer are given in 2-pp Bulletin W-8. A diagram shows installation. Golden-Anderson Valve Specialty Co.

119 **Fabricated Fittings** — As a practical help in planning piping and equipment layouts, Bulletin 525 offers specifications and prints on standard fittings for lightweight pipe. Also presents illustrations of special fabrications designed to save time and labor and reduce material costs in modernizing piping systems. Naylor Pipe Co.

120 **Pipe Fabrication Standards** — Standards Bulletin 281-1952 entitled, "End Preparation and Internal Machining for Machined Backing Rings for Butt Welds," supersedes previous standards bulletin. The new edition meets present-day high pressure and high temperature piping requirements and includes design changes that minimize amount of weld material required and resultant shrinkage stresses in the weld. Pipe Fabrication Institute.

HEATING

121 **Unit Heaters** — Catalog NGC-10-52, 8 pp, features a full-color cutaway illustration of a Thermobloc direct-fired heating unit. Various models manufactured by company are illustrated by photos and drawings. Specifications and dimensions included. Thermobloc Div., Pratt-Daniel Corp.

122 **Heat Exchanger for Process Industries** — Bulletin HF-101, 8 pp, introduces the Hoto-Flight Processor, a new heat exchanger for cooling, heating, cooking and drying. Tells how it affords control of the flow of material as to duration of treatment, and control of the quantity and temperature of heat exchange agent. Discusses dispersion convection principle utilized and stresses the versatility, compactness and other advantages of the processor. Western Precipitation Corp.

Two more post cards are provided for you on pages 137-138

123 **Oil Heat Exchanger** — This folder describes and pictures an oil heat exchanger and oil clarifier designed as a combined integral unit and intended to prevent many of the undesirable mechanical conditions encountered in the operation of diesel powered equipment. Illustrates equipment, explains how it minimizes engine wear; describes separator element. J-B Engineering, Inc., Ltd.

124 **Holding Heat** — A 50-pp booklet titled, "Heat Enclosure Methods," could serve as a textbook on the subject of enclosing heat. Beginning with the history and development of arch construction, the text covers boilers, oil stills, steel heating units, open hearths and special units. Graphs, tables and other engineering data are presented to aid in selection of proper construction for any combination of heat and operating conditions. There's also a chapter on fuel as it affects furnace design. Illustrated in color. M. H. Detrick Co.

AIR CONDITIONING, DUST AND MOISTURE CONTROL

126 **Air Conditioners** — Central station-cabinet type air conditioning units are illustrated and described in Bulletin 114. The functions and purposes of four commonly accepted types of unit assemblies are graphically presented by means of chart drawings and tabular matter. Power engineers will find the check list of functional elements helpful in the preparation of specifications. National Association of Fan Manufacturers, Inc.

127 **Data on Dust Filters** — Bulletin 102 describes in detail manufacturer's new Dynaclone dust filter designed primarily for the continuous process industries where uniform suction at all dust points is essential. Bulletin gives complete engineering data on this equipment, including construction details, principle and applications. The W. W. Sly Mfg. Co.

128 **Controlled Humidification** — How manufacturer's steam humidifiers serve to reduce weight and quality loss, as well as production and human efficiency loss and fire loss is told in 12 pp Bulletin 1773. Some causes of dry air are explained, and best methods of overcooming it discussed. Humidifying equipment is described and pictured and illustrated case histories of a dozen installations are provided. Also includes directions for installing the humidifiers. Armstrong Machine Works.

129 **Efficient Dehumidifying** — Bulletin 222 is a 32-pp new edition of this company's popular booklet showing how modern dehumidifying equipment solves the problem of "moisture where it ought not to be." Illustrated by 70 photos and diagrams of actual installations, describes production, handling and storage jobs protected by such installations. Pittsburgh Lectrodryer Corp.

MATERIALS HANDLING

130 **Materials Handling Systems** — Power engineers concerned with the transportation and disposal of commercially dry material ranging from fine dust to lumps will be interested in newly-published Catalog 752, 20 pp, on this company's Hydrovac systems. Discusses and illustrates four principal components: materials handling valve, piping and fittings, vacuum equipment, and disposal equipment. Includes suggested arrangements. The Allen-Sherman-Hoff Co.

131 **Conveyor Belt Lacing** — Bulletin A-70 describing company's Alligator long length conveyor belt lacing contains application views, sizes and prices and other pertinent information. These separable fasteners can be furnished in any length, with hinge pins, for joining flat conveyor belts up to 96 in. wide, 1/8 in. thick. Flexible Steel Lacing Co.

132 **Conveyor Belting** — In a thorough analysis of company's B-G belt, this 8-pp bulletin shows how its construction is designed to defeat the major causes of belt failure, such as ply separation, carcass deterioration, irregular plies, edge wear and others. Selection tables are provided. Barber-Greene Co.

HOSE AND COUPLINGS

133 **Metal Hose** — Illustrated Catalog CMH-130, 32 pp, presents full range of company's Rex-Weld corrugated flexible metal hose, Rex-Tube convoluted hose types, and Rex-Flex stainless steel flexible metal hose, giving complete specifications. Also covers coupling types, special assemblies, and installation information. Flexonics Corp.

134 **Basic Industrial Hose** — Illustrated in color, this 8-pp pamphlet describes company's new "Basic-Five" line of color-coded multi-purpose hose, which replaces 18 former types and thus affords reduced inventories. Bulletin gives details of construction, sizes, lengths, pressures, recommended couplings and uses. Thermoid Co.

135 **Metal Hose** — Bulletin CMH-115R describes company's RT-6 and RT-8 flexible metal hose, all purpose tubing and ducting. Gives full specification data on both types, illustrates applications. Flexonics Corp.

136 **Engineering Data on Flexible Couplings** — Providing 78-pp of engineering information on company's full line of all metal flexible couplings for power transmission Catalog 51 is arranged for easy reference. Couplings are grouped and indexed, and Keyway data, standards for straight and tapered bores, and ordering

(Continued on page 137)

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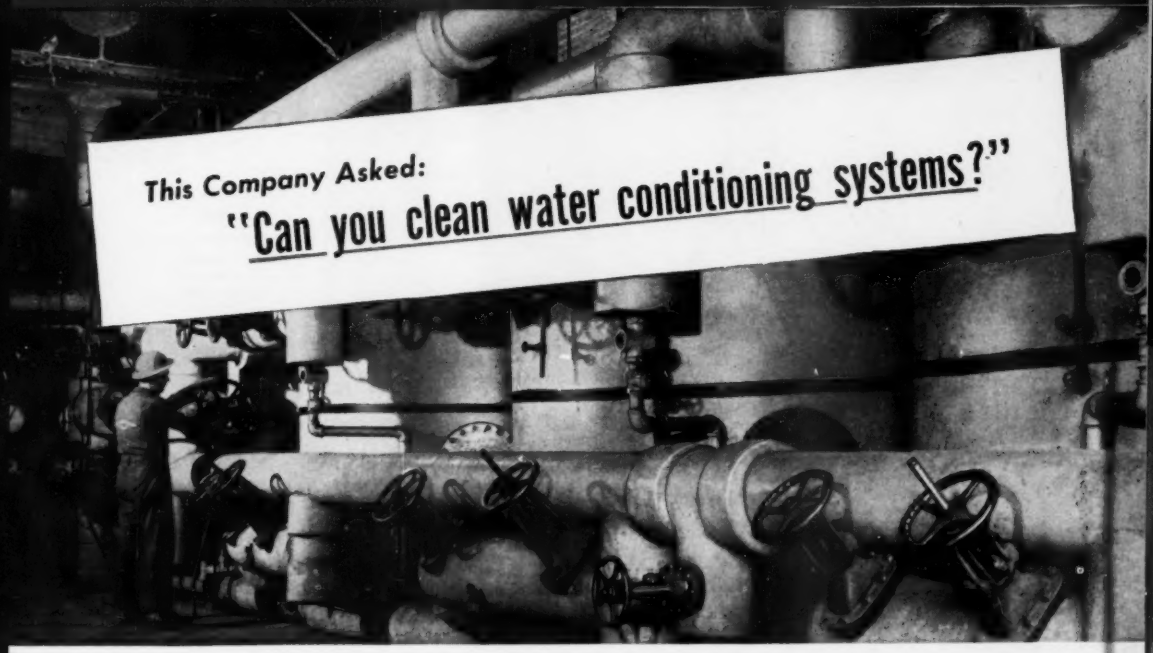
DOWELL SERVICE

CHEMISTRY APPLIED TO MAINTENANCE CLEANING PROBLEMS



Dowell Service has cleaned many types of water supply equipment FAST!

If deposits are cutting production and profits in your plant . . . Dowell Service offers an effective remedy! For example, in water supply and water treating systems, deposits may accumulate in pipes, pumps and filters . . . impairing operating efficiency. Maintenance men in many industries rely on Dowell Service to clean operating equipment . . . *without dismantling and with a minimum of downtime!*

Experienced Dowell engineers do the job, using Dowell-designed, truck-mounted equipment. Liquid solvents designed to remove deposits quickly, efficiently and economically are applied according to the techniques demanded by the job: for example, by filling, spraying, jetting, cascading or vaporizing. Often equipment can be cleaned in operation.

Let Dowell Service *save you time and money* in your maintenance cleaning! Call the nearest Dowell office today for FREE consultation.

Recent Dowell jobs in Feedwater Systems

SCREEN FILTERS: In less than three hours, Dowell Service removed 90% of deposits from filters used to screen river water for a 48" strip mill.

WATER SOFTENER: Approximately 18 inches of hard calcium carbonate piled up in the bottom of a water softener's deaerating compartment. In less than one day, Dowell Service thoroughly cleaned compartment.

FILTER BEDS: The backwash rate on an anthracite filter was reduced to 75 gallons per minute by accumulated deposits. After Dowell Service, backwash rate was increased to an effective 385 gallons per minute.

ION EXCHANGE BEDS: Iron oxide clogged an ion exchange water softener. Before cleaning, two pumps were required to provide pressure for adequate back wash. After Dowell Service, one pump was sufficient.

FEEDWATER LINES: Before cleaning, it was necessary to use three 100 horsepower pumps to force water through clogged feedlines to a boiler house. Following Dowell Service, only one pump was required.

PUMP: Two high pressure feedwater pumps were nearly clogged with deposits. Dowell service completely cleaned them along with rest of the feedwater system.

WATER WELL: Before treatment, a water well produced only 108 gallons per minute with a 35' drawdown. After Dowell acidizing, water flow increased to 450 gallons per minute with a 27' drawdown.

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Cleveland 13	New Orleans 12	Lafayette, La.	Wichita Falls, Texas
Pittsburgh 19	Shreveport 69	Dearborn, Mich.	Hobbs, N. Mex.

★ *Maintenance cleaning service for industrial heat exchange equipment.*

★ *Chemical services for oil, gas and water wells.*

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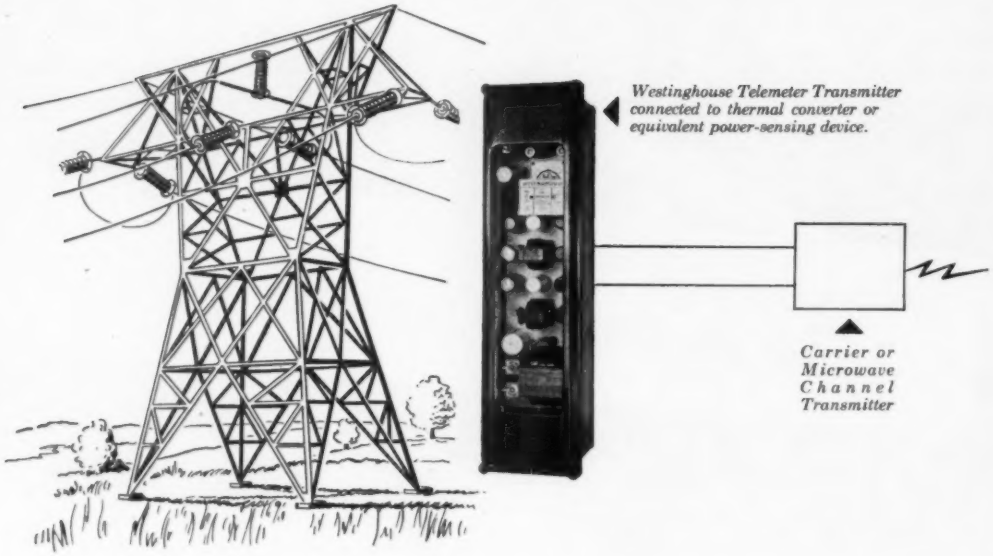

Westinghouse Telemeter Transmitter connected to thermal converter or equivalent power-sensing device.
Carrier or Microwave Channel Transmitter

Accurate, instantaneous

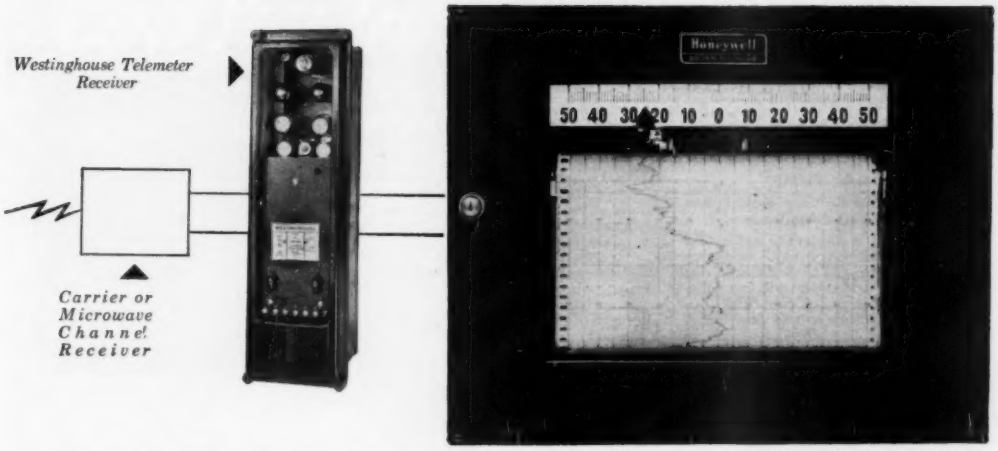
Flexibility... Dependability... for all power plant measurements

The versatile *ElectroniK* recorder is applicable to measurement of pressure, flow, speed, pH, conductivity, power, current, voltage, temperature . . . the *same basic instrument for all*, with changes only in measuring circuit and sensing elements. Use of standard, interchangeable components simplifies maintenance, reduces parts-stocking problems. Single-point and multi-point models are available in a choice of printing speeds, and with chart speeds from ½" to 120" per hour.

The utmost in dependability demanded by power plant applications is insured by *ElectroniK* components . . . life-tested, service-proved, designed for minimum, easy maintenance. These rugged "building blocks"—the high-torque balancing motor, the hermetically sealed converter, the simplified continuous-balance amplifier—typify construction that minimizes the number of moving parts, and that eliminates troubles from dust and atmospheric humidity.

● *Important Reference Data*

Write for Instrumentation Data Sheet No. 9.1-9, "Improved Westinghouse Telemetering System"... and for



Westinghouse **Freq-O-Tron** *continuous telemetering system (variable frequency type) with* **ElectroniK** *strip-chart recorder*

***ElectroniK** Recorder*

facts on system loads

through continuous telemetering with ElectroniK RECORDERS

THE ultra-fast telemetering equipment shown above keeps the load dispatcher in constant touch with all parts of the system. It tells him every change in tie line interchange, in station generation, and in system load—the instant that a change takes place. Operating over carrier current or microwave channels, it spans distances of hundreds of miles . . . eliminates the delays and uncertainties of intermittent, non-continuous measurement.

The *ElectroniK* recorder presents load data in full, readable detail on its big, 11-inch-wide strip chart, where every significant change and trend stands out for the dispatcher's attention. The rapid response of *ElectroniK* continuous-balance measurement assures full utilization of the inherent speed of the telemetering equipment. And the industry-proved dependability of *ElectroniK* construction means absolute minimum maintenance, and uninterrupted performance.

Your local Honeywell engineering representative will be glad to give you full details. Call him today —he is as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4587 Wayne Ave., Philadelphia 44, Pa. Service available promptly from more than 55 offices in principal cities of the United States.

MINNEAPOLIS
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BROWN INSTRUMENTS
First in Controls

Bulletin 90-2, "Supervisory Instruments for Power Generation."

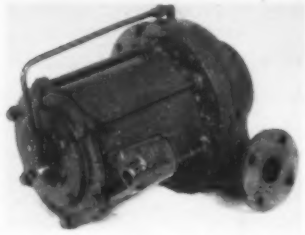
Equipment News

SUMMARIZED HERE are new products and improved ones . . . recent developments of leading manufacturers who will gladly supply further information at no cost. You may use the no-obligation, postage-free cards on pages 38 and 137 for your request. Just list the numbers of the items you'd like to know more about

1—CENTRIFUGAL PUMP

Is designed for long service and greatly reduced maintenance

The Chempump is claimed to be the first pump applicable to general industry that requires no seal, no stuffing box or packing gland. It is a compact, one-piece combined motor-and-pump unit intended for operation in any position. A separate base isn't required, but can be furnished. The Chempump is designed



to handle any clear liquid and many slurries, and manufacturer says proper construction materials can be furnished to meet most corrosion-resistance requirements.

A main advantage of this seal-less pump is reduced maintenance and servicing. External lubrication isn't required, company stresses; pump or bearing lubrication is provided by the fluids handled — or in the case of abrasive fluids by factory installed lubricants. Also, the Chempump is enclosed to keep out dust and moisture. Literature describing available models is available. Chempump Corp.

2—VAPORIZING CRYSTALS

To protect metal surfaces and parts from corrosion without coating

Protection against rust without coating is the chief characteristic of VPI, a volatile amine nitrite. The product is required in small quantities and protects by giving off a vapor which condenses on the metal surfaces to provide a thin film. VPI can be applied by placing it in crystal form in a package containing parts to be protected; by blowing the crystals into an area, or by dissolving it in a water or alcohol solution and spraying it on. Shell Oil Co.

3—POLE-TOP UNIT

Incorporates disconnecting and lowering mechanism

Safe, efficient ground-level maintenance is declared possible for lights mounted on new standard metal poles of any height with this new disconnecting and lowering pole-top assembly. Since the maintenance man works at ground level with a "dead" fixture (live contacts stay at pole top) there are no climbing or electrical hazards, manufacturer points out, and the fixtures can be serviced more frequently and at less cost. Also, greater mounting heights, often ruled out because of the lack of a practical means of servicing, are possible with the new assembly.

The unit includes a pole-top fitting with self-contained pulley, divided mast-arm, stainless steel operating cable and mast-arm end fitting. The high-strength aluminum alloy mast-arm contains a Y-shaped partition for stability and separation of the movable operating cable from the electrical wiring. The mast-arm end fitting, incorporating the hanger mechanism, features a self-contained "plumbizer" to provide for 8 deg adjustment either side of center line. Complete details on the assembly are given in Bulletin WPH-52-2. Thompson Electric Co.

4—FLEXIBLE VALVE SHIELD

Is designed to protect operator against hazardous spray

Made of neoprene synthetic rubber, this shield is for use on valves handling acids and other hazardous chemicals. It serves to protect the valve operator or nearby workers from injury if the valve stem packing should fail — it cups the stem and the packing gland and keeps acid from spraying.

The shield is molded in the shape of a flower pot. To install it you cut or punch a hole in the bottom slightly smaller than the valve stem. Then you remove the valve wheel, and pull the shield down over the stem so it covers the packing gland. It doesn't have to be

wired in place, company points out, and it can be installed while the valve is in service. Being flexible, it can be turned back to inspect the valve or tighten packing gland nuts, and since it doesn't have to be removed for such purposes there's no risk that it won't be replaced. The shield comes in three sizes costing $1.60, $2.40 and $3.90. E. I. duPont de Nemours & Co.

5—WINDING TESTER

Is portable, electronic device; shows location, nature of fault

Said to be so sensitive it can detect a single shorted turn of No. 40 AWC wire, the PMD Tester is designed to detect faults in and prevent breakdowns of electrical motors and generators and generators of all sizes and types, coils and similar electrical equipment. It can be used on both a-c and d-c devices and its test probes generate their own field

in the probes, company adds. The field oscillates at 800 cycles.

The motor tester consists of a power supply unit, a vacuum tube oscillator, a regulator and a rectifier circuit, equipped with standard tubes and full-view meter — all housed in a portable case. The unit weighs only 13 lb. Rod-like single probes are used to test distributed windings. Field coils and squirrel cage rotors are tested with double probes. Columbia Technical Corp.

6—SWITCHSTICK DEVICE

Is designed for easy removal or replacement of cutout doors

This attachment is a stainless steel fitting for clamping to the head of any standard switchstick. It can be used for switchstick-handling of doors with all G-E enclosed, indicating dropout cutouts, 5.2 or 7.8 kv, 50 or 100 amp, manufactured since 1935, and with G-E 5.2 kv, 100 amp, heavy duty cutouts. The attachment folds back against the switchstick to assure no interference with ordinary uses. General Electric Co.

7—PLASTIC GASKET MATERIAL

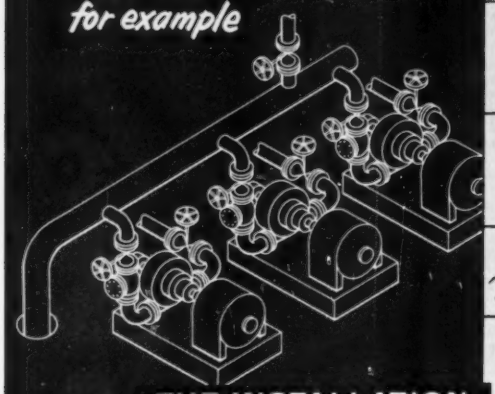
Is offered as solution to vacuum line sealing problems

By adding a $\frac{1}{64}$ in. film or coating of this plastic gasket material to flange faces and gasket surfaces vacuum line leakage is reduced to a minimum, according to manufacturer, and slight leakage which may occur after the line has been in service for a while can be

corrected by adding a $\frac{1}{32}$ in. coating of the material around the outside surfaces of the flange where they meet with the gasket. The practice can be repeated many times to increase the life of the

Can You Trust Your Checks to Hold Like This?

...on Water Pumps, for example



THE INSTALLATION

Crane Iron Body Swing Check Valves in 8-inch vertical lines on discharge side of water pumps supplying a large eastern paper mill.

VALVE SERVICE RATINGS

SUITABILITY:	Working smoothly - no complaints
FEATURES:	O.K. for either horizontal or upward flow
MAINTENANCE COST:	None - no maintenance needed to date
SERVICE LIFE:	Now better than other checks used
OPERATING RESULTS:	No water or head loss
PRICE:	In line with other makes
AVAILABILITY:	Stock item - Crane product

THE HISTORY

The mill depends on these pumps for all water. Loss of head at the pumps would create a serious problem. The mill could take no such risks. Regularly, the check valves on pumps were replaced, but only to be found leaking between pumping cycles, a few months later.

It's now more than a year since the change-over was made to Crane Check Valves. There's been no loss of water, no maintenance or replacement of any checks on the pumps. That was proof enough for the mill, that Crane Quality means better valves —greater dependability and bigger value. As a result, 3 more of these checks were installed on a separate battery of suction pumps.

THE VALVE

Crane No. 373, 125-Pound Iron Body Swing Check Valves, brass trimmed. The long life and high seating efficiency of these checks, in 2 to 8-in. sizes, is in large part due to the Crane patented flexible disc-hinge design. Double spring mounting eliminates lost motion between parts, yet permits true, full contact of disc and seat at every closure. Also serves to absorb the shock of seating under backflow pressure. See your Crane Catalog or Crane Representative for full details.

The Complete Crane Line Meets All Valve Needs. That's Why

More Crane Valves Are Used Than Any Other Make!

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois

Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

seal. It is also pointed out that where flange faces are un-marred and come together true, the plastic gasket material can be used by itself without any other type of gasketing material. It is formulated in two types: one for air, steam, water, mild chemicals; the other for oil, gasoline, solvents. Flexrock Co.

8—INTER-LOCK RECEPTACLE

Is designed to make cord sets safe for hazardous locations

This new receptacle incorporates a sealed mercury switch which de-energizes each socket before a plug may be inserted or removed. This eliminates danger of sparking, manufacturer points out. The mercury switch works on a cam lever which locks cord set caps in position after they are inserted. In the locked position this switch completes the circuit. A flip upward of the cam lever tilts the switch, breaks the circuit and allows the cord caps to be pulled out. The new device incorporates standard, single or duplex receptacles to fit conventional cord sets. Complete details available on request. Tigerman Engineering Co.

9—VALVE OPERATOR

Airmotor diaphragm type, for modulating control applications

This operator is designed for use on any of company's valves, normally open, normally closed, three-way or slides. It operates by pneumatic pressure applied to the chamber above the diaphragm and is adaptable for manual or remote control systems. The new operator is said to be ideal for modulating control of valves where accurate control of flow is desired with applied diaphragm pressure. Mounting space is provided for control instruments and pneumatic pressure regulators. The new operators are available in 13- and 16-in. diaphragm sizes. General Controls Co.

10—REPAIR KIT

For "on-the-job" repair of electric welding or power cable

The Fast Fix Cable Repair Kit contains tools and replacement parts for putting new lugs on No. 14 through No. 6 power cable and splicing or putting new lugs on No. 6 through No. 4/0 welding or

ground cable. Rubber sleeves and friction tape are provided for insulating and finishing jobs.

Of special interest is the "Tweco" lug set block and punch provided for installing solder type lugs and splicers mechanically. Tools and parts are packaged in a compartmented steel box with instructions included. Gas Arc Supply.

Use post cards on pages 38 and 137 for more information on any of these products

11—REFRACTORY FIBER

Vitreous aluminum silicate, of unusual thermal properties

Made from inert materials at 3300 F, Fiberfrax is said to resist temperatures to 2300 F without loss of properties and not soften at temperatures approaching 3000 F. Because of the fineness of the fibers and their random arrangement, Fiberfrax is also reported to have excellent filtration characteristics, to be resilient, light in weight and not subject to corrosion by most chemicals.

At its present stage of development, Fiberfrax is available only in bulk form; but work is under way to produce it in felted blanket rolls, batts, tape and paperlike forms. Its applications as thermal insulation are expected to include use in bulk or packed form for furnaces, for pipe and expansion joints.

Use of Fiberfrax is also foreseen as a reinforcing agent to strengthen electrical insulation, support catalysts, reinforce battery plate; as a resilient support, as a flame arrestor and for other purposes. Carborundum Co.

12—RELIEF VALVES

Are combined temperature- and pressure-relieving valves

The 202 Series Relief Valves for use on hot water tanks and heaters are actually a combination of two of company's valves in one assembly. For guarding against both excessive temperatures and pressures they offer savings in cost and installation time. They are of the automatic reseating type, Btu rated for proper selection.

An important innovation in the 202 Series is the fixture connection, a ¾ in. tapped opening which permits taking service water flow directly through the body of the valve. Besides simplifying piping hook-up, this arrangement is designed to eliminate any accumulation of air in valve chamber and keep the thermostatic element subjected to the temperature of the service water to eliminate any temperature lag. The valves are available with standard opening pressure settings of 75, 100 or 125 lb. McDonnell & Miller, Inc.

13—CIRCUIT BREAKER

Miniature type, fits standard plug-type fuseholders

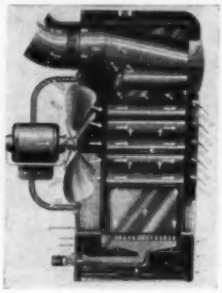
Mini-Breaker is a new miniature branch circuit breaker that can be installed like a fuse in any standard Edison base fuseholder delivering 110–125 v a-c service. It requires no additional equipment and no rewiring when applied as a direct replacement on existing fuse-protected circuits of corresponding 15, 20 and 30 amp ratings. Manufacturer says anyone can install it in seconds and anyone can restore electrical service after an overload or short circuit simply by pressing in and releasing the device's shock-proof reset button.

Although it somewhat resembles the fuse it is designed to replace, Mini-Breaker is a thermally-actuated circuit breaker, company points out. In operation it interrupts excessive overloads and short circuits — tripping instantly on shorts, but with a built-in time lag to handle temporary starting loads and line surges, it is explained, and it will not maintain a circuit that has not been cleared. Mini-Breakers in 15, 20, and 30 amp ratings are now in production, according to manufacturer; when commercially available they will be listed by Underwriters' Laboratories. Literature and price data on Mini-Breakers is available. Mechanical Products, Inc.

14—UNIT HEATERS

Gas fired, feature heat exchanger that's built like a boiler

A new streamlined series of unit heaters includes six models in capacities from 50,000 to 230,000 Btu per hour input. Heart of the new design is the heat exchanger with its horizontal tubes staggered to provide maximum areas of prime heat surface. It is generously sized



for smooth, quiet air passage, manufacturer states, and the steel tubes are rolled into heavy end sheets, boiler tube style, and fortified with additional outer and inner rolled flanges. Air-tight operation is said to be assured by the continuous seam welding of end plates to sides. A brush can be passed between the tubes for easy cleaning.

The heat generator includes burner heads and mixing tubes of one-piece cast iron construction. Burners, pilot and control valves are combined in one removable drawer-type assembly. Full performance data and specifications on these heaters are given in Bulletin DS-347. The Trane Co.

15—STATIONARY BATTERY

For applications requiring up to 24 amp-hr at 8-hr rate

Housed in transparent plastic, the Type CME Exide-Manchex Battery is intended for all small power stationary applications. Several advantages are credited to its container and cover of polystyrene: it is impervious to the electrolyte, is easily cleaned and affords lighter weight and more compact size — increased power output per unit of space. The plastic case also affords more attractive installations.

Other features announced for this battery include long-life Manchester positive plate and double insulation. Mipor separators, of microporous rubber, together with slotted polystyrene separators act as a permanent electrical insulation while permitting free diffusion of electrolyte. Capacities of 8, 16 and 24

How to make packings last longer

Tips by Johns-Manville Engineers to help you keep production rolling

The old packing gives the clue to most packing failures...

I was ruined by shaft misalignment. When old packing shows excessive reduction in cross-section directly beneath rod, shaft or plunger, bad alignment is indicated. Leakage usually occurs around top of shaft or rod. Cause may be worn bearings which permit shaft to whip.

Too much gland pressure did me in. Badly deformed rings next to the gland follower, with bottom rings in fair condition, suggest excessive gland pressure or improper installation. Excessive gland pressure sometimes causes packing to extrude between follower and rod or shaft.

Lack of lubrication made things too hot for me. If the wearing faces of the rings are dried out or charred, with the rest of the packing in usable condition, the trouble probably is lack of lubrication. Excessively high operating temperatures and wrong type of packing can cause similar symptoms.

I'm worn out because I turned with the shaft. Unusual wear on the outside circumference of the packing almost always indicates one of two conditions. The rings may be binding on the shaft and rotating with it, or the packing is too loose in the stuffing box and moving with the rod.

Why you can count on Johns-Manville

INTERLOCKED ROD PACKING

Because it's braided square, not braided round and pressed square. J-M Interlocked Packing lasts longer . . . has a better contact area . . . makes a tight seal with medium gland pressure. J-M Interlocked is recommended for both reciprocating and rotating service, for use against steam up to 500°F; hot and cold fresh and salt water; oils; weak acids and caustics.

Your distributor will help, too! Your J-M Packing Distributor can help you take the guesswork out of packing problems. He carries complete stocks of Johns-Manville quality packings and can supply you promptly. For the address of the J-M Packing Distributor nearest you, write Johns-Manville, Box 60, New York 16, N. Y.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville PACKINGS & GASKETS

amp-hr are available. Two- and three-cell assemblies may be combined to provide desired voltage and fit available space. Form 5328 gives further details. The Electric Storage Battery Co.

16—PILLOW BLOCKS

All steel; are compact and rugged, with high load carrying capacity

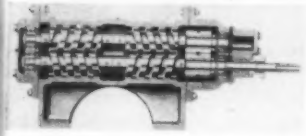
Announced as a joint achievement by Dodge Mfg. Corp. and Timken Roller Bearing Co., these bearings are said to offer high radial and thrust capacities and the stamina to take heavy shock loads and yet be compact in size and lighter than usual in weight. Self-aligning with spherical outer race, they come in both expansion and non-expansion types and have adapter mounting. Double piston ring seals serve to keep lubricant in and dirt and dust out of the bearing mechanism. The bearings are sealed both on and off the shaft.

While these bearings are not yet ready for delivery it is expected that they will be carried in stock and provided in shaft sizes from $2\frac{15}{16}$ to 10 in., and will be shipped ready to install. They're expected to find major use in crushers, heavy conveyors and other heavy duty machinery. Dodge Mfg. Corp.

17—SCREW PUMP

Internal gear and bearing type; capacities from 1 to 700 gpm

This new internal gear and bearing type screw pump for positive displacement of lubricating fluids or semi-fluids is offered as a companion product to company's previously announced "bracket type"



screw pump of external gear and bearing type for moving non-lubricating fluids.

Special points of interest in the new pump are heavy duty roller bearings just inboard of the timing gears where radial load is heaviest; lock nuts behind the timing gears for simpler repairing, and double-row angular contact ball bearings at the rear end which position the rotors axially. Discharge pressures are 1000 psi for viscous liquids, and 500 psi for the light oils. Sier-Bath Gear and Pump Co., Inc.

18—STEEL SEAT UNION

Zinc coated, or black, is impregnated with rust resistant

This integral seat 300 lb steam pipe union is made from sealless and forged steel and is designed for 2000 lb cold water, oil or gas, non-shock, or 300 lb steam pressure. Company announces that because of improved production techniques these unions are lower in price than many similar unions. The Capitol Mfg. & Supply Co.

19—SEMI-METALLIC PACKING

Is $\frac{1}{16}$ in. dia, for use on small valves and fittings; self sealing

Power engineers concerned with maintenance of small valves and fittings, especially those handling steam, gasoline and oil, will be interested in the $\frac{1}{16}$ in. Steamfitters' Special Packing. Said to be the only one of its kind now available, it is suggested for fittings requiring a small, self-sealing packing which is unaffected by the heat of steam. It is designed for temperatures to 350 F and pressures to 125 psi.

This packing is described as a semi-metallic material which is self-forming, self-lubricating and self-sealing. Its lubricating action is not washed away by solvent action of gasoline or petroleum products, company states. Packing Div., Flexrock Co.

20—SIGNALING UNIT

Consists of tone transmitter, frequency selective receiver

This new duplex signaling unit is designed to operate over wire lines, telephone or power line carrier, and radio or microwave communication circuits. The units may be used to transmit and receive signaling, dialing, telemetering, supervisory controls or other information. It is intended for use by power companies and others requiring remote on-off switching, continuous indication of operating conditions and automatic detection of wire line or power source failures along their systems. Hammarlund Mfg. Co., Inc.

21—OIL CIRCUIT RECLOSER

Heavy duty, three-phase, for pole pole or substation use

Specifically for application on distribution lines where high fault currents may be encountered, the new Kyle Type R Recloser is designed to afford a highly accurate means of protection against system outages due to faulted feeder circuits — and through simultaneous three-phase tripping, to prevent the possible occurrence of feed back through three-phase loads.

The Type R is available in nominal load ratings from 25 to 280 amp and has a maximum interrupting rating of 6000 amp on systems up to 4.8 kv and 4000 amp on systems up to 14.4 kv. It may be either pole or station mounted. In operation this recloser is automatic and self contained, with all opening and closing operations simultaneous for all three phases. Line Material Co.

22—MAGNETIC PROBE

Is improved device for removing steel or iron particles

The new model of company's well known magnetic probe is made of super-strength magnetic alloy. The probe is the size of a fountain pen and the point of the magnet is extended or retracted from the case by turning the end-knob. Strength of magnet can be controlled by amount of extension. Among the many industrial uses of the probe is the removal of ferrous particles from the operating area of electrical instruments or delicate mechanisms. The probe costs $6.50. General Scientific Equipment Co.

Want more details on these new products? Use the post cards on pages 38 and 137

23—CERAMIC PIPE

And special joint are developed for low-pressure uses

A newly introduced ceramic pipe is easily joined and installed by means of plastic and vitrified clay joints which form a leak-proof and infiltration-proof union, according to the manufacturer. The pipe is resistant to corrosive chemicals and suitable for carrying most liquids, company states, and will withstand a 4-ft head. Curves, turns, Y's and elbows are easily and quickly installed with the new pipe and joints. Robinson Clay Product Co.

24—BELT DRESSING

Is packaged in pressurized can for easy application

Designed for increasing the efficiency of flat or V-belt drives, Spragrip comes in a pressurized can. It is claimed that a squirt of this new dressing will prevent slippage of even slack belts, thus lengthening bearing life. A. W. Chesterton Co.

25—OVERLOAD RELAY

For power transformers, now has indicating dial

The Type TRO Thermal Overload Relay is now equipped with an indicating dial. Calibrated in per cent thermal load, the dial gives a continuous visual indication of the thermal condition of the transformer. A new concept in thermal indication, the term "per cent thermal load" has a universal meaning under any ambient temperature, company says, and needs no interpretation in terms of time-temperature limits of winding insulation or possible loss of life due to overloading. Coordinated with the relay, the 100 per cent position on dial corresponds to "signal" position of the relay and 110 per cent mark corresponds to "trip" point.

Readable from ground level, the dial also has a maximum indicating hand that remains in the position of greatest deflection of the indicating pointer. This pointer can be reset manually from the ground. The new relay with dial is interchangeable with company's older units now in service, but the dial can't be attached to presently installed relays. Westinghouse Electric Corp.

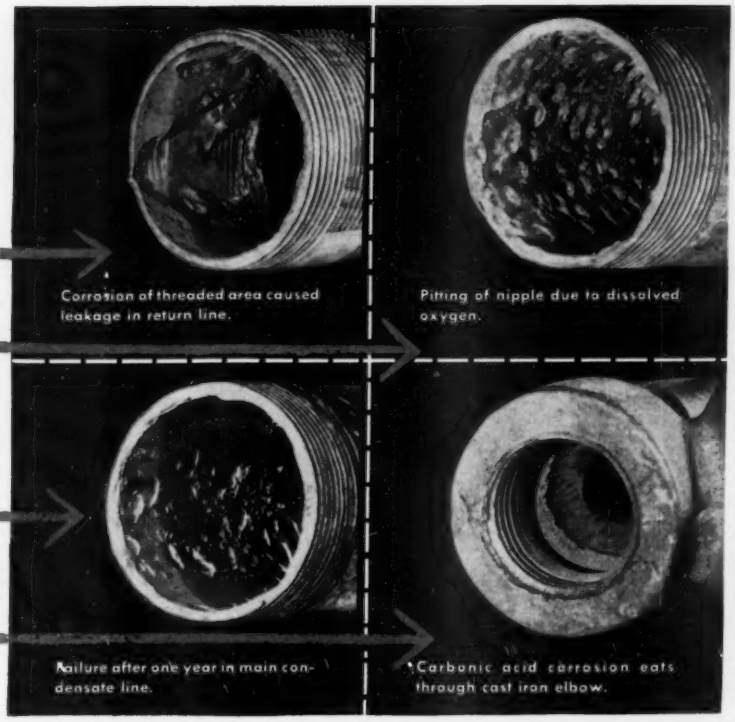
26—FLOORING MATERIAL

Is designed to resist action of solvents, many acids

Of special interest is the fact that Latex-O-Crete may be applied directly over the old surface at an average depth of only $\frac{1}{4}$ in., according to manufacturer, and no preparation other than thorough cleaning is required.

Latex-O-Crete is shipped ready for application. It is designed to resist the destructive action of chemicals, many acids, food fats, solvents and other agents which cause deterioration of floors. Company says it will withstand heavy traffic from materials handling equipment. United Laboratories, Inc.

victims of Return Line Corrosion


Corrosion of threaded area caused leakage in return line.
Pitting of nipple due to dissolved oxygen.
Failure after one year in main condensate line.
Carbonic acid corrosion eats through cast iron elbow.

Dearborn Formula 702 will prevent Corrosion caused by low pH values

Excessively low pH values of water—caused by dissolved carbon dioxide—result in corrosion that destroys return line sections such as these.

The destruction of such valuable parts is easily and economically prevented with Dearborn Formula 702. Introduced directly into the boiler feed water, Formula 702 forms a continuous amine-type film on the return lines to effectively coat the lines against corrosion. In addition, Formula 702 will automatically repair any surface where the film has been broken by loosened rust scale, and also improve heat transfer in the line, thereby reducing the cost of steam production.

Your Dearborn Engineer will gladly demonstrate how you can reduce the cost of maintenance and avoid shutdowns with Dearborn Formula 702. Why not call him today?

DEARBORN CHEMICAL COMPANY

Merchandise Mart Plaza • Chicago 54, Illinois

BASIC PATENTS

Dearborn holds the basic patents (U.S.Pat. 2400543) for the use of filming amines for treating water.

YOU'LL WANT A COPY OF THIS BULLETIN Bulletin 5013, which outlines the causes of return line corrosion and the method of cure with Formula 702, will be sent on request.

Dearborn Chemical Company Dept. PG
Merchandise Mart Plaza
Chicago 54, Ill.

☐ Send a copy of Bulletin 5013
☐ Have a Dearborn Engineer call

Name.....

Position.....

Company.....

Address.....

City.....*Zone*.....*State*.....

Dearborn
TRADE MARK REGISTERED
THE LEADER IN WATER TREATMENT AND RUST PREVENTIVES

POWER PLANT *Construction News*

Pine Bluff, Ark. — Arkansas Power & Light Co., Pine Bluff, plans expenditure of about $26,000,000 for expansion in Cecil Lynch generating station, Rose City, Ark., and Harvey Couch power plant at Stamps, Ark. Capacity of both plants will be doubled with installation of new turbine-generators, high-pressure boilers and auxiliary equipment. Financing has been arranged. Program will require a number of months for completion.

Sacramento, Calif. — Proctor & Gamble Co., Gwynne Bldg., Cincinnati, Ohio, soaps and detergents, vegetable compounds, edible and inedible oils, etc., plans steam power house at new refining plant at Fruitridge and Power Inn Rds., Sacramento, where large tract of land has been secured. It is understood that new plant will be used for production of commercial alcohol, consisting of group of one and multi-story structures, equipped for large capacity. Entire project is reported to cost close to $12,000,000.

San Leandro, Calif. — Bd. of Alameda County Supervisors, Court House, Oakland, Calif., has approved construction of new boiler house for central-heating service at Fairmount Hospital, San Leandro, and work will proceed at early date. Construction will be carried out in conjunction with a new shop building at institution, entire project to cost over $800,000.

Frostproof, Fla. — Clinton Foods, Inc., 445 Park Ave., New York, N. Y., frozen citrus fruit concentrates, etc., plans boiler house at proposed new plant at Frostproof, where site has been selected. It will consist of several buildings for processing and production. Entire project estimated to cost about $1,000,000. Work will be carried out soon.

Ridgewood, Fla. — Davison Chemical Co., Davison Chemical Bldg., Baltimore, Md., industrial and agricultural chemicals, fertilizers, etc., plans boiler house at new plant at Ridgewood, near Lakeland, for production of triple superphosphate for commercial fertilizer service. It will comprise a number of buildings, equipped for large output. Cost reported in excess of $2,500,000.

Atlanta, Ga. — Georgia Power Co., Electric & Gas Bldg., is arranging an expansion and improvement program for a 36-month period, 1952 through 1954, to cost approximately $129,800,000, including generating stations, power substations, transmission lines and other operating facilities.

Chicago, Ill. — Commonwealth Edison Co., 72 West Adams St., has arranged for sale of a bond issue of $40,000,000, proceeds to be used for expansion and improvements in plants and system, including generating stations, power substations, transmission lines and other operating facilities.

Mason City, Iowa — North Iowa Cooperative Processing Association, Manly, Iowa, Glen Pogeler, general manager, has approved plans for new soybean oil processing mill, with boiler plant, at Mason City. It will comprise a main one-story building for processing and general production. Cost reported in excess of $500,000.

Waterloo, Iowa — Armour Fertilizer Works, Hurt Bldg., Atlanta, Ga., commercial fertilizer products, plans boiler house at proposed new branch plant at Waterloo, where site has been selected. Plant will be equipped for an initial capacity of 60,000 tons per annum and is reported to cost over $1,500,000, with equipment. Company is an affiliate of Armour Co., Union Stock Yards, Chicago, Ill.

Great Bend, Kan. — Western Light & Telephone Co., Huron Bldg., Kansas City, Kan., has plans under way for new steam-electric generating plant at Great Bend. Details of installation will be determined soon. Cost reported in excess of $3,000,000. Sargent & Lundy, Inc., 140 South Dearborn St., Chicago, Ill., is consulting engineer.

Lawrence, Kan. — Consumers Cooperative Association, 318 East 10th St., Kansas City, Mo., plans steam-generating station at proposed new plant at Lawrence for manufacture of nitrogen fertilizer. A number of one and multi-story buildings will be erected for processing and general production, equipped for an annual output of about 110,000 tons. Entire project will represent a reported investment of close to $15,000,000. A new affiliate is being organized under name of Cooperative Farm Chemical Association to carry out program. Howard A. Cowden is president and general manager of Consumers Cooperative Association.

Alexandria, La. — Central Louisiana Electric Co., will expand about $16,500,000 for expansion and improvements in plants and system in 1952 and extending into 1953, including increased generating facilities, power substations, transmission lines, etc.

Chamois, Mo. — Central Electric Power Cooperative, Chamois, has plans maturing for new steam-electric generating plant on local site, reported to cost about $3,500,000, with turbine-generator, high-pressure boilers and auxiliary equipment. Kuljian Corp., 1200 North Broad St., Philadelphia, Pa., is engineer.

St. Louis, Mo. — R-C Can Co., 101 Chambers St., paper cans, paper tubes and kindred paper goods, plans boiler house at proposed new converting plant on local site. It will be one-story, about 95,000 sq ft floor space. Cost reported over $500,000. Joseph G. Harms, 440 South Brentwood Blvd., Clayton, Mo., is architect.

Woodbridge, N. J. — Ronson Art Metal Works, Inc., 1 Aronson Sq., Newark, N. J., cigarette lighters, parts, etc., has preliminary plans under way for new plant near Woodbridge, where production will be concentrated in future. A boiler house will be built in conjunction with main factory building and auxiliary structures. No official estimate of cost announced — will represent a large investment.

Artesia, N. M. — Southwestern Public Service Co., Amarillo, Texas, has approved plans for new steam-electric generating plant at Artesia, and will proceed with foundations at once. Installation will include new turbine-generator, high-pressure boilers and auxiliary equipment. Cost reported over $7,000,000.

Mandan, N. D. — Standard Oil Co. of Indiana, Inc., 910 South Michigan Ave., Chicago, Ill., plans power house at proposed new oil refining plant at Mandan. It will comprise a series of one and multi-story production units and will have a charging capacity of 15,000 bbl of crude oil daily. Entire development will represent a reported investment of about $15,000,000.

Boardman, Ohio — Metal Carbides Corp., 107 East Indianaola Ave., Youngstown, Ohio, tungsten carbide tools, metals, etc., plans boiler house at proposed new plant at Boardman, near Youngstown. It will comprise a main production and processing building, and several auxiliary structures. Entire project reported to cost approximately $1,000,000.

Portland, Ore. — Pacific Power & Light Co., Public Service Bldg., Portland, is considering construction of two new hydroelectric generating plants on tributaries of Lewis River, including a station on Swift Creek, to be equipped for an initial capacity of 50,000 kw; and plant on Muddy River, with rating of 35,000 kw. Estimates of cost are being made. Application for permission has been made to Federal Power Commission, Washington, D. C.

Holtwood, Pa. — Pennsylvania Water & Power Co., Lexington Bldg., Baltimore, Md., plans new steam-electric generating station and coal preparation plant at Holtwood. Details are being determined and work is expected to begin soon. Financing has been arranged. Cost estimated about $27,500,000, with a new 220-kv transmission line to Safe Harbor, Pa., about 32 mi.

Knoxville, Tenn. — Tennessee Valley Authority, Knoxville, will construct a series of steam-electric power plants in connection with the program of Atomic Energy Commission, Washington, D. C., in Southern area. Government appropriation of $150,000,000 is being arranged. TVA power plant construction and work on project is expected to begin soon.

Beaumont, Texas — Gulf States Utilities Co., 362 Liberty Ave., has arranged an expansion and improvement program in plants and system to cost approximately $78,500,000, majority of fund to be used for increased generating facilities. Company will expend about $25,500,000 in 1952; $32,000,000 in 1953; and approximately $21,000,000 in 1954. Other expansion will include transmission lines, power substations, distribution systems, etc.

Calallen, Texas — Texas Power & Light Co., Corpus Christi, Texas, plans new steam-electric generating station on site near Calallen, to be equipped for an initial rating of about 66,000-kw. Cost reported about $5,500,000, with transmission lines, power substations and other operating facilities.

Longview, Texas — Tennessee Eastman Co., Division of Eastman Kodak Co., Kingsport, Tenn., plans boiler house at proposed new plant at Longview for manufacture of polyethylene plastic materials. It will consist of a number of one and multi-story buildings, equipped for large capacity. Entire project is reported to cost about $6,500,000. Project will be carried out by Texas Eastman Co., recently organized subsidiary.

Correction: — In the item headed **East Dunkirk, Indiana,** page 48, July 1952 issue an error occurred. It was based on the Defense Power Administration release (DPA-316) dated April 23, 1952, regarding certificates of necessity. The facts are:

Indiana & Michigan Electric Co. applied for certificates of necessity on its Tanners Creek steam plant Unit 3, near Lawrenceburg, Indiana, also for transmission and terminal facilities in the vicinities of Fort Wayne and East Dunkirk, Indiana. Total estimated cost of these facilities was $41,899,000 and DPA certified $41,869,000 as eligible.

Of the total estimated cost, close to 70 per cent will be for Tanners Creek Unit 3, over 23 per cent for three high-voltage transmission lines, and over 7 per cent for four substations.

Tanners Creek Unit 3, scheduled for service in July 1954, will be rated at 200,000 kw, and will be operated on 2,000-psi, 1,050-F steam with 1,050-F reheat. It will raise Tanners Creek rating to 500,000 kw, and contribute to service of Indiana & Michigan Electric Co. and increased National Defense needs on the 7-state integrated American Gas and Electric System.

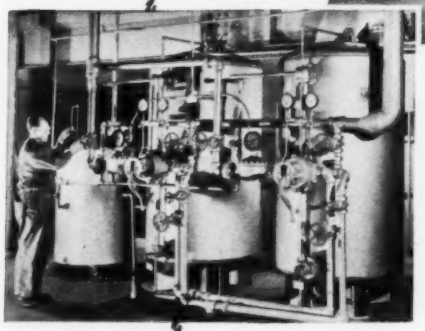
ALLIS-CHALMERS

Water Conditioning

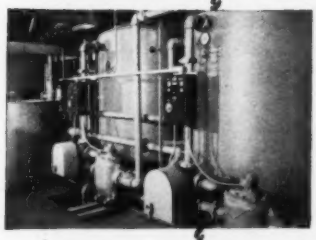
CHEMICALS — EQUIPMENT — SERVICE

FOR WATER *that Fits Your Needs*

This hot process lime-soda softener for treating makeup to high-pressure boilers is rated at 5000 gph.



Sodium zeolite water conditioning equipment with capacity of 130 gpm provides boiler makeup to evaporator in an eastern utility power plant.



Dual automatic sodium zeolite water softener rated at 225 gpm is used in power plant of a Texas hospital.

TO ASSURE YOU water conditioned to your specific requirements, A-C engineers can draw on years of experience treating all types of water . . . plus a broad background of building turbines and processing equipment that are dependent on properly treated water. A-C water conditioning service includes:

Chemicals — for external and internal boiler water treatment . . . designed for silica removal and control of scale, corrosion and carryover. Also cooling cycle treatments . . . and dependable reagent chemicals.

Equipment — hot and cold process softeners . . . sodium and hydrogen zeolite softeners . . . alkalinity-reducing ion exchangers . . . deionizers . . . degasifiers . . . deaerating heaters . . . chemical feeding equipment . . . pumps . . . oil removal and water filters.

Comprehensive consultant service — surveys, reports . . . chemical and X-ray analysis . . . special studies.

WRITE FOR THESE BULLETINS

28X7636 — Meaning, Application and Measurement of pH

28X7559 — Hot Process — Hot Zeolite System

28B6611 — Hot Process Softener

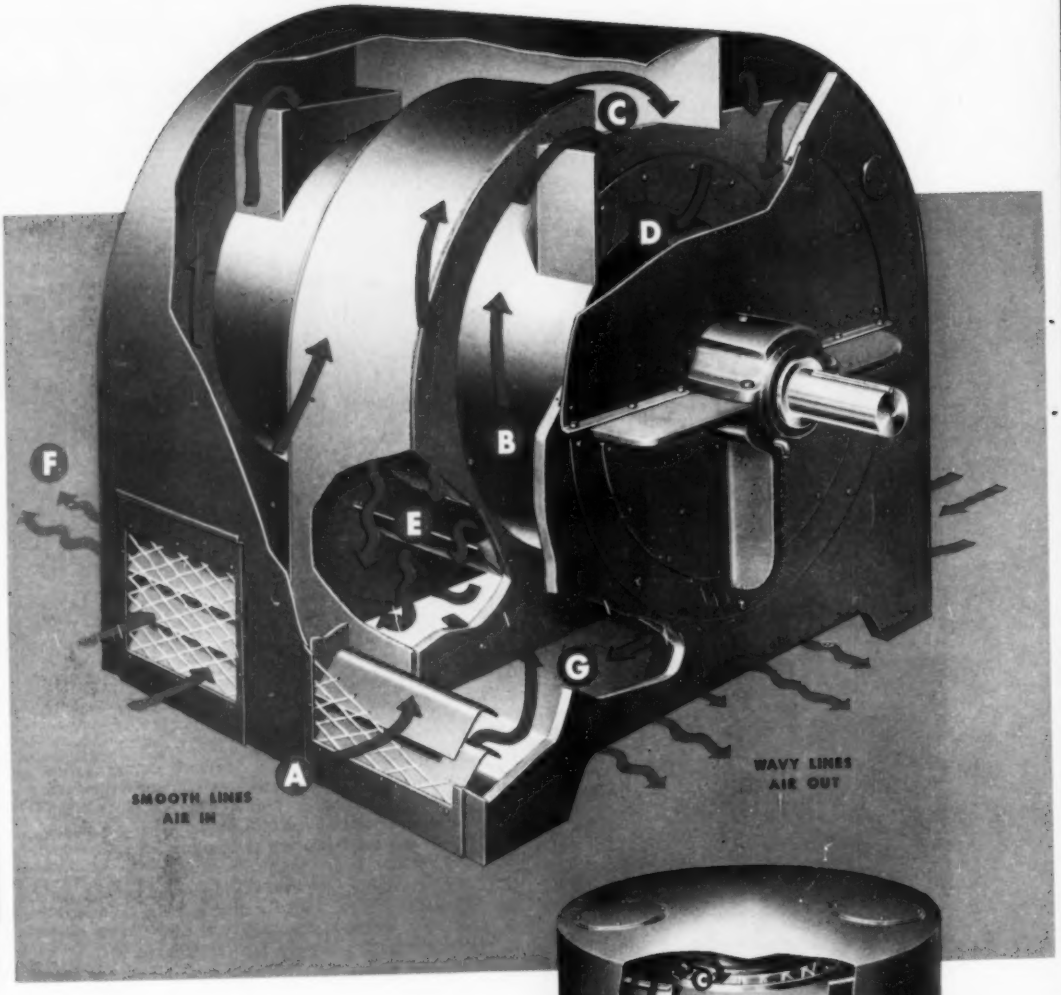
28B7107 — Sodium Zeolite Softener

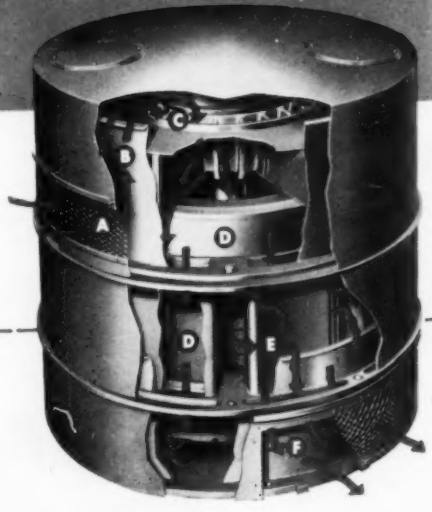
28X7808 — Alkalinity-Reducing Ion Exchanger

ALLIS-CHALMERS

A-3827

Milwaukee 1, Wisconsin





VERTICAL OUTDOOR MOTOR

New Outdoor Motor

dares weather to do its worst!

You can install these induction motors outside—any place—and forget the weather. They're naturals for power station auxiliary service, in fact, any place where a motor must stand up to weather—wind, rain, or hail as long as the ventilated openings are unobstructed.

Look at the cutaway drawing at the left. You can see that the motor is completely enclosed by a steel shell. Note how air enters the shell at the bottom (A), flows up and around in the motor shell (B), to top (C), where it is drawn down and into the interior of the motor (D). Warm air is discharged from motor (E) and out enclosure ends (F).

Now, what happens when moisture, rain and sleet are present in the air? The air is drawn in at point (A). As the air rises at a slow velocity, water, sand and other heavier-than-air particles fall to base (G) where a drain carries them away. Result? Regardless of outside conditions, only clean dry air enters the motor.

Remember, too, this motor includes features that have made Westinghouse Induction Motors leaders in industry. For example: Sectional covers and air shields, easily removed by hand. Split bearing housings, with bearings readily accessible for inspection or replacement. Sturdy welded steel frame; stronger, lighter, smaller.

Also, vertical-type outdoor motors are available with features that have made Westinghouse motors leaders in industry.

Get the facts now for immediate use or with an eye toward future requirements. See your Westinghouse representative or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-10375

YOU CAN BE SURE...IF IT'S Westinghouse

LARGE INDUCTION MOTORS

Boiler-Burner Team Wins Seven Straight

Phillips Chemical Company orders Vogt boiler and Coppus-Dennis FANMIX burner combinations to make 1¾ million pounds of steam an hour

When a customer praises a product, that's fine. But when a customer *continually re-orders*, that's conclusive proof of user-satisfaction.

Phillips Chemical Company, Borger, Texas — producer of synthetic rubber — first installed Henry Vogt boilers with FANMIX burners back in 1943. As plant production increased, Phillips again purchased the same equipment — in 1946, and again in 1951.

Today, a total of 7 Vogt boilers equipped with Coppus-Dennis FANMIX burners provide 1,750,000 lbs. steam each hour for the production of synthetic rubber. The boilers are designed for 250,000 lbs. steam peak operation but have been operated as high as 275,000 lbs. per hour. Their performance is typical of the efficiency of boilers equipped with Coppus-Dennis FANMIX burners.

FANMIX · Better Combustion · Better Efficiency · Higher Ratings

All Coppus-Dennis FANMIX burners — for gas as well as combination gas-oil — have the exclusive FANMIX action. Their *revolving orifices* give violent mechanical mixing and agitation of gas and air, therefore causing instantaneous and complete combustion with *minimum excess air* (5% excess air is not unusual).

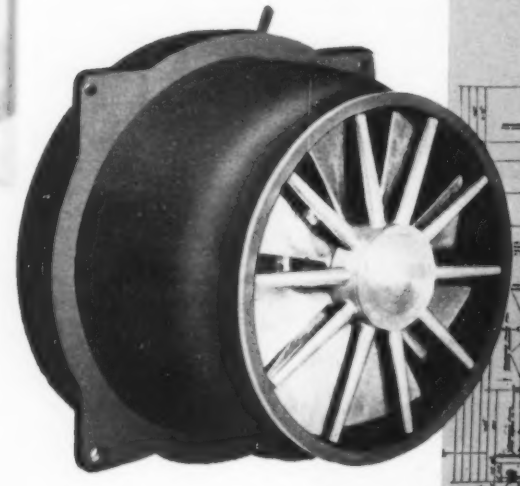
Because of this exclusive FANMIX action, furnace space is not required for mixing and *higher boiler ratings* are thus easily obtained. The burners also have a shorter flame than any other burner and will not cause flame impingement.

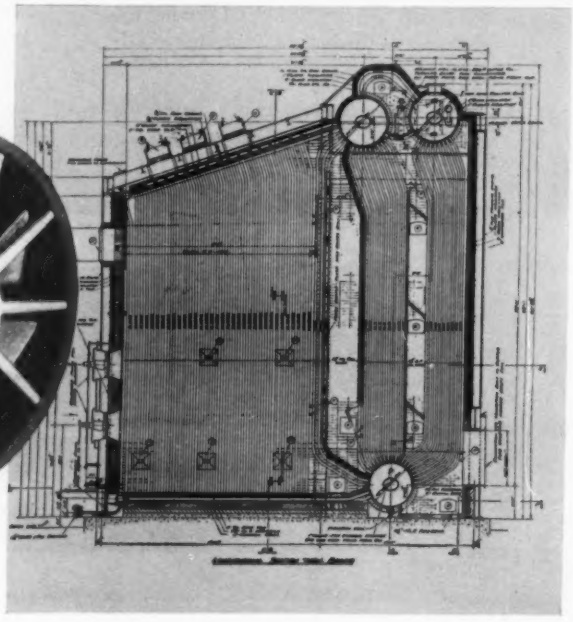
What's more, by incorporating a *fan* as an integral unit, FANMIX burners have *no draft loss* across the burner. As a result, increased ratings are possible regardless of draft conditions.

FANMIX action, with its quick completion of combustion, gives *lower* exit temperatures.

If you are not using Coppus-Dennis FANMIX burners in your present boiler, why not plan now to take advantage of the exclusive FANMIX action? You need no forced draft equipment, increase in stack or increase in furnace volume for FANMIX operation. And you get increased capacity. When specifying FANMIX on *new* boilers, you can plan on reduced combustion space, higher ratings, less stack height or reduced induced draft capacity — and, of course, *no* forced draft equipment.

For further information, mail coupon today. Sales offices in *Thomas' Register*. Other "Blue Ribbon" Products in *Chemical Engineering Catalog, Refinery Catalog, Best's Safety Directory* and *Mining Catalogs*.





JET REACTION is utilized to rotate fan which is integral part of burner. Ideal mixture for fast, complete combustion and peak efficiency is caused by automatically proportioned high velocity air passing at right angles through fuel.

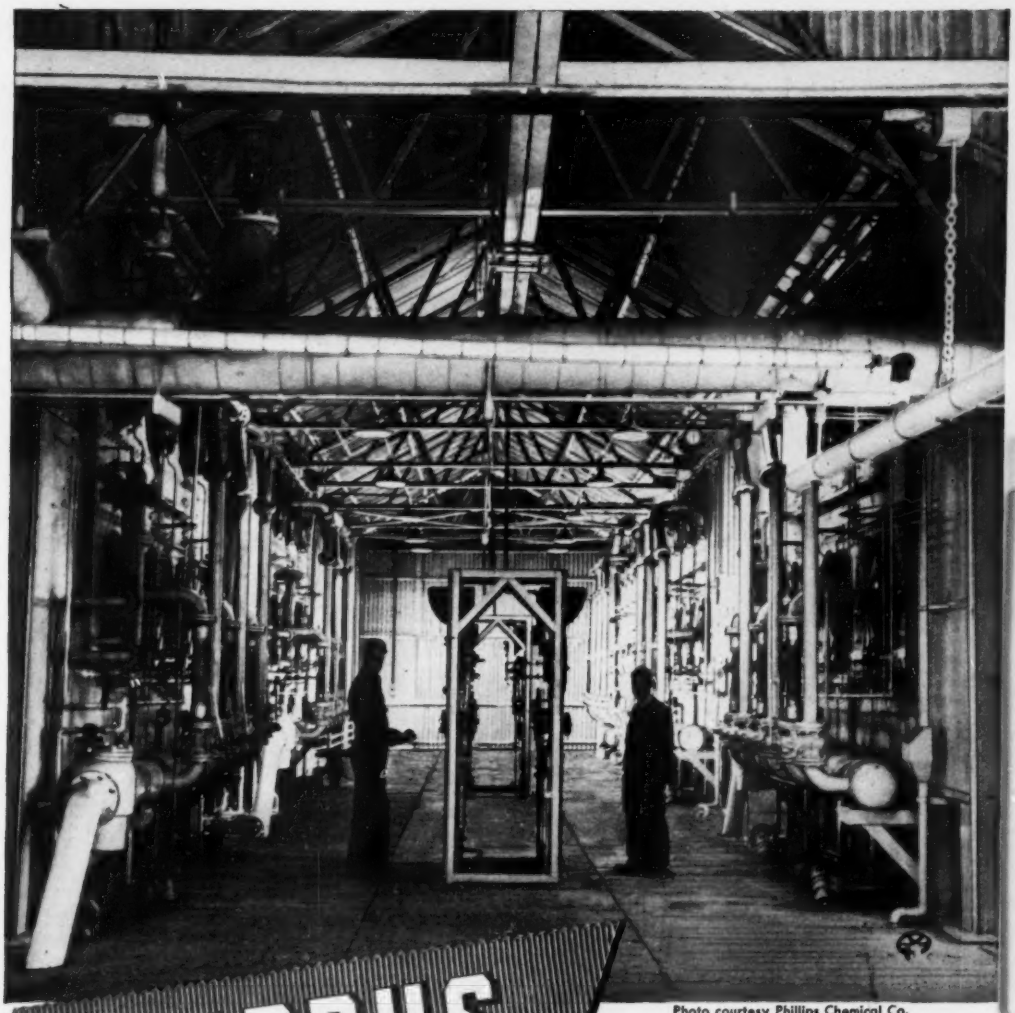


Photo courtesy Phillips Chemical Co.

HENRY VOGT BOILERS are here shown installed in the Phillips Chemical Company, Borger, Texas. Boilers use Coppus-Dennis FANMIX burners.

SEND COUPON for further information. Coppus engineers FANMIX burners to your individual requirements.

PLEASE ATTACH THIS COUPON TO YOUR COMPANY LETTERHEAD

COPPUS ENGINEERING CORPORATION
170 Park Avenue
Worcester 2, Massachusetts

Please send complete data on Coppus-Dennis FANMIX Burners. I'm particularly interested in ☐ gas ☐ combination gas-oil.

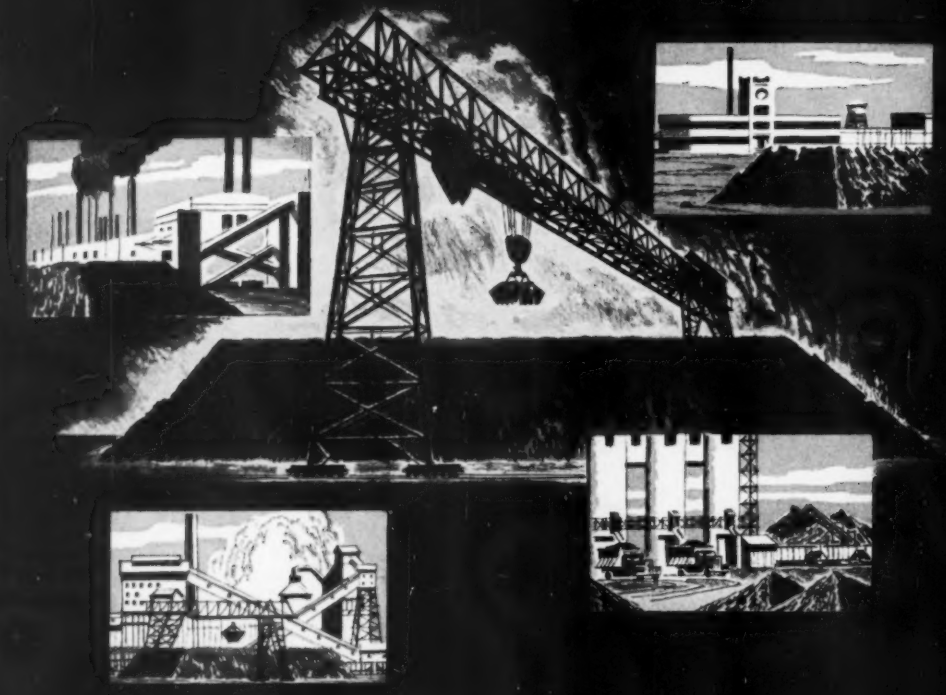
Name.....Title.....

Company.....

Address.....

City.....Zone.....State.....

tomorrow's fuel supply



BEACON COAL

EASTERN GAS AND FUEL ASSOCIATES

PITTSBURGH • BOSTON • CHICAGO • CLEVELAND • DETROIT
NEW YORK • NORFOLK • PHILADELPHIA • SYRACUSE

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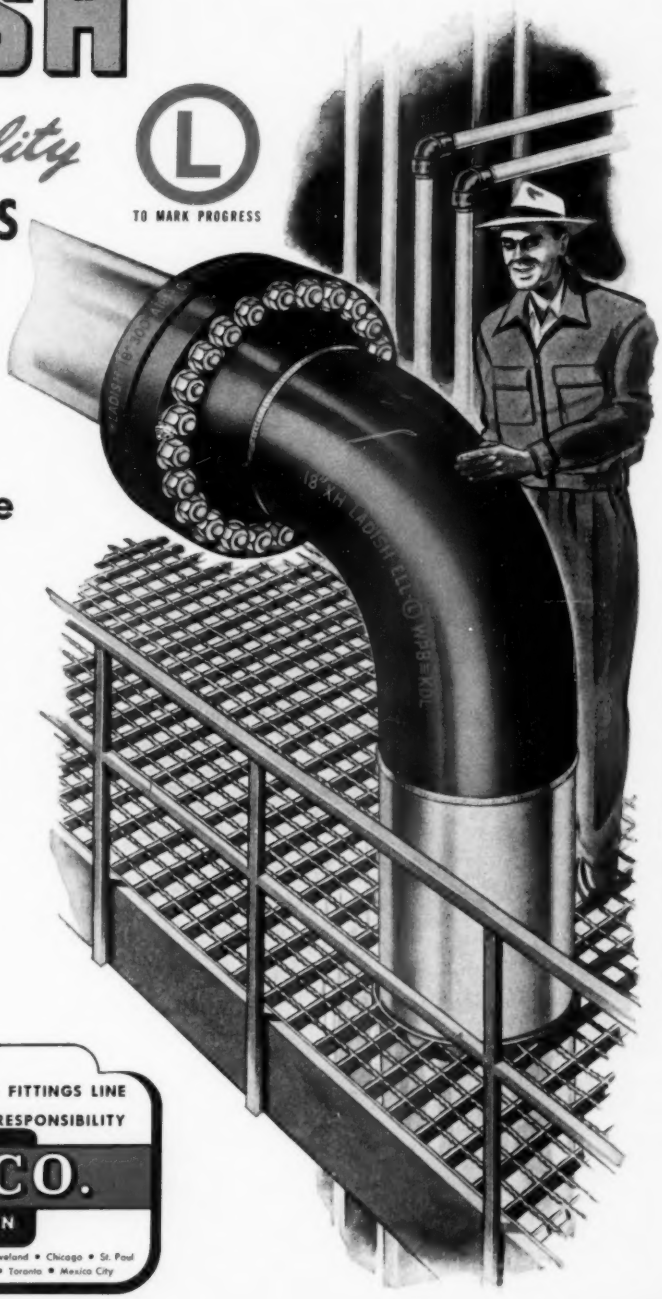
EASTERN GAS AND FUEL ASSOCIATES
BEACON COAL

LADISH

Controlled Quality

PIPE FITTINGS

TO MARK PROGRESS



metallurgically sound for maximum service

Sound metallurgy . . . the result of unsurpassed facilities and advanced laboratory controls . . . provides the maximum of dependability in Ladish Controlled Quality fittings. Every phase of metal quality . . . composition, structure and physical properties . . . is continuously safeguarded—and certified proof of metallurgical integrity is available to users of Ladish fittings.

THE COMPLETE *Controlled Quality* FITTINGS LINE
PRODUCED UNDER ONE ROOF...ONE RESPONSIBILITY

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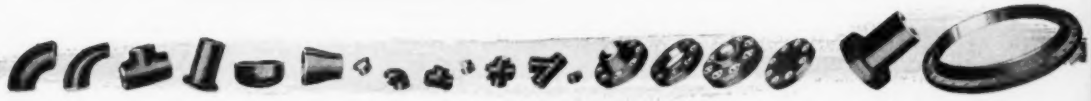

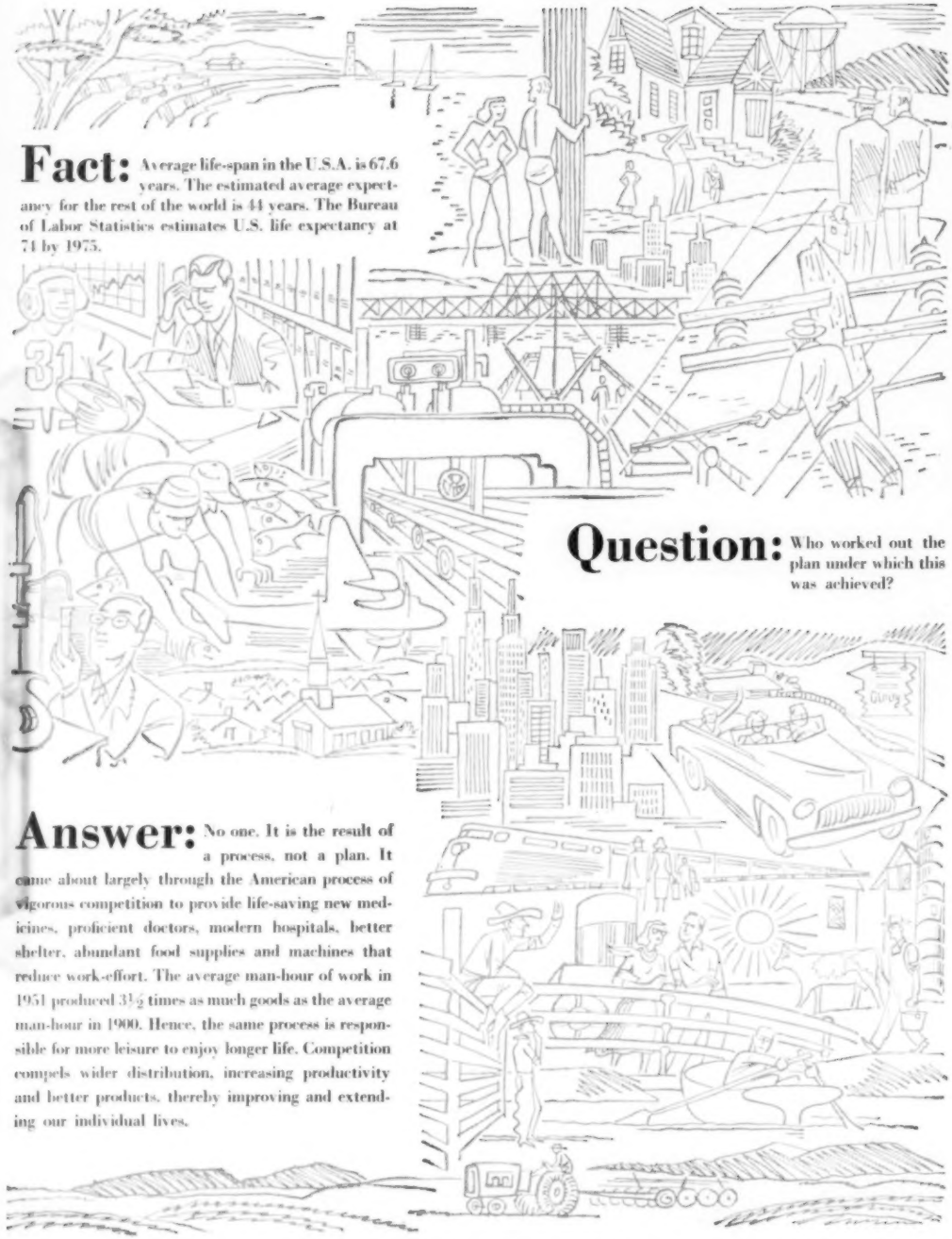

Fact: Average life-span in the U.S.A. is 67.6 years. The estimated average expectancy for the rest of the world is 44 years. The Bureau of Labor Statistics estimates U.S. life expectancy at 74 by 1975.

Question: Who worked out the plan under which this was achieved?

Answer: No one. It is the result of a process, not a plan. It came about largely through the American process of vigorous competition to provide life-saving new medicines, proficient doctors, modern hospitals, better shelter, abundant food supplies and machines that reduce work-effort. The average man-hour of work in 1951 produced 3½ times as much goods as the average man-hour in 1900. Hence, the same process is responsible for more leisure to enjoy longer life. Competition compels wider distribution, increasing productivity and better products, thereby improving and extending our individual lives.

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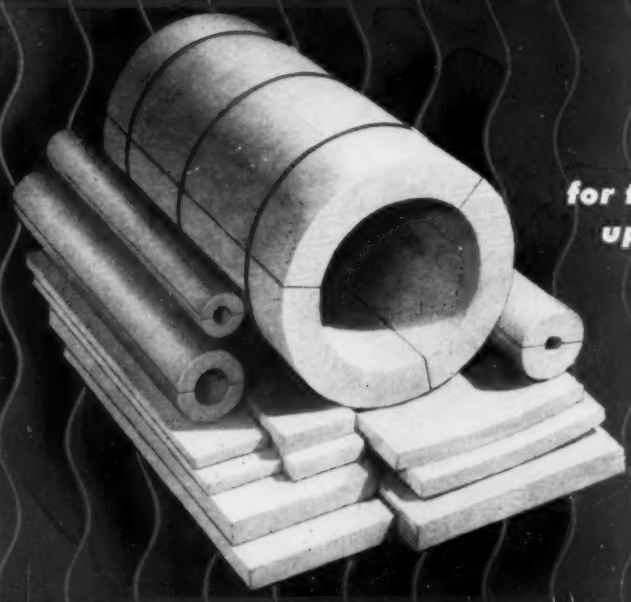

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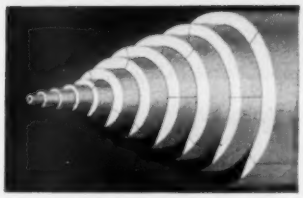

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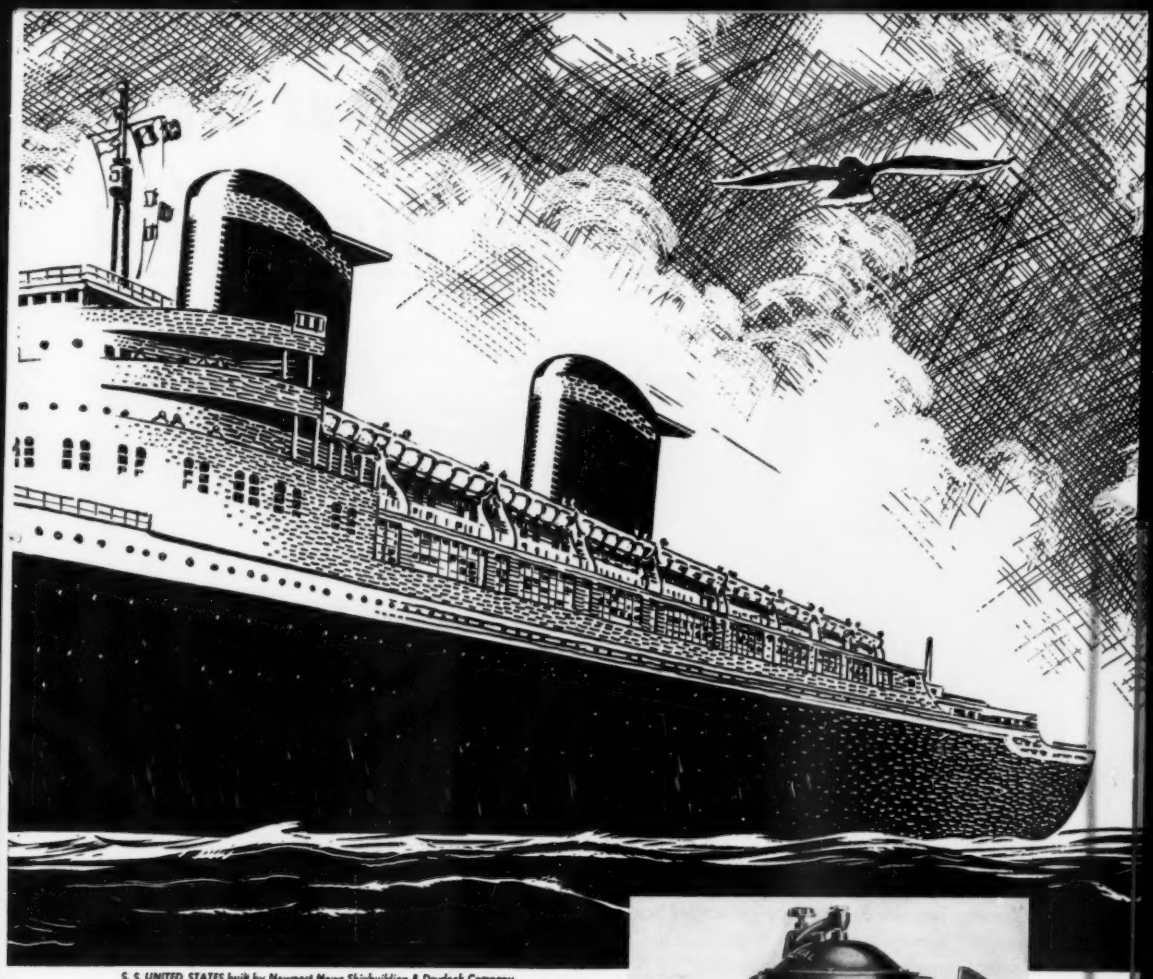

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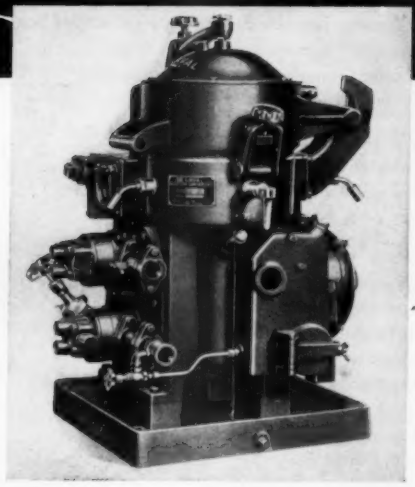

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Here and There

With The Editors

IN MILWAUKEE, WISC., over a recent week-end, we stopped in to see M. K. Drewry, Chief Engineer of Power Plants, of Wisconsin Electric Power Co. to check on our story on their new Oak Creek Station. . . . (We published it in our July issue). . . . Discussion swung to old stations and equipment. . . . Hence, Mr. Drewry suggested that a visit to their Commerce Street Station was in order.

There we were given the $100 tour by the watch engineer. . . . In Commerce Street you can see under one roof the whole history of steam engineering. . . . All equipment is in perfect operating condition and is still in use, from the old horizontal steam engines and pumps, and slow-speed vertical turbines, right through to the latest in horizontal, high-speed, hydrogen-cooled turbine generators.

One interesting fact brought out by the watch engineer was that the young men coming in as new operators will handle the modern high-pressure, high-temperature, high-speed equipment with no trouble at all. . . . But when they have to operate the old steam engines, in which the basic laws of steam power are used, they are scared of them.

This station is used to supply heat for buildings in the downtown area of Milwaukee and also acts as standby. . . . However, they are generating d-c, and are the only ones doing it, for certain customers. . . . For the d-c supply, they are generating directly and are also rectifying some a-c.

★ ★ ★

We found that the Troy Municipal Power Station at Troy, Ohio, has a new extension to the old station. . . . Two new boilers and turbine-generating units have been installed and provision made for a third unit. . . . One service this station is rendering the town it serves seems quite different from most. . . . The power plant has a large water softener that not only supplies soft and treated water for the boilers but also supplies soft water for the entire town. . . . This is a bad place for a home water softener company to try to do any business.

★ ★ ★

For a really effective power interchange arrangement between a private power plant and a utility system, the one between the power plant at Pennsylvania State College and West Penn Power Co. can be considered tops. . . . At night surplus electric power produced at the College plant as a result of the steam heating load is sold to the West Penn Power system. . . . During the day when the electric power demand is high, and also in summer when the steam load is light, power is purchased by the University from the utility. . . . The College supplies the power company in excess of 1,000,000 kwh a year, mostly during the night hours. . . . Penn State power plant, operated under the able direction of R. Y. Sigworth, Supervisor of Utilities, has had a long and interesting growth, the most recent addition being a new 5000-kva Elliott turbine generator and an 839-hp B & W boiler. . . . The very capable supervisory staff of the college is shown in the picture.

Here's an excerpt from a letter we have just received from Harold F. Dawe, of The Stearns-Roger Mfg. Co. of Denver, Colorado: —

"I notice, in your column Power Plant Calls, August 1952, an interesting item about a Hero turbine. I might mention that the Mechanical Engineering Department of the Iowa State College, Ames, Iowa, has a similar model, which they have had on display for many years. It is actually operating every year during the 'Veiska' week at the College, an open-house period when the facilities of the college are displayed. No doubt other engineering schools also have models of the turbine."

Thanks for the tip, Mr. Dawe; we'll be watching for more of these turbines as we travel around.

Fact is, another Hero (or Heron) turbine model was on display at the Museum of Science and Industry in Chicago in connection with the Centennial of Engineering celebration (see September issue, page 70).

This turbine is just like the one we showed in August except that it includes what is believed to be the source of steam for the original. . . . That source was a closed vessel shaped much like a wash-basin, with a flat top that supported the turbine trunnions. . . . When a wood or charcoal fire was built under the vessel, which was filled with water, it generated steam that flowed up through the trunnions and operated the turbine.

★ ★ ★

On our way East recently, we were fortunate to be able to stop at Rochester, N. Y., and meet I. G. McChesney of Rochester Gas and Electric Co. who designed the air meter for combustion control, that is being used so successfully at their Russell Station. . . . We gave you all the details of this in the December 1951 issue of POWER ENGINEERING, *pages 80–81. . . . Mr. McChesney is a flyer and is licensed to fly anything up to and including four-engine planes. . . . He stated that the design of the air flow meter was nothing new, really, but was based on a Venturi action. . . . All it amounts to, he says, is an air-foil section in a duct. . . . The idea for this, naturally, came from his flying experience. . . . He has been swamped with letters asking about it and says he feels like the fellow who had invented a new mouse trap.*

★ ★ ★

Just thought you might like to see the fine looking group of men who handle the physical plant at Pennsylvania State College. In the photograph at the left, they are, in usual left to right order: Standing, rear — Walter H. Wiegand, Physical Plant Exterior Construction; C. A. Larner, Supervisor Building Maintenance; Walter W. Trainer, Landscape; G. W. Ebert, Director Physical Plant (retired); R. Y. Sigworth, Supervisor of Utilities.

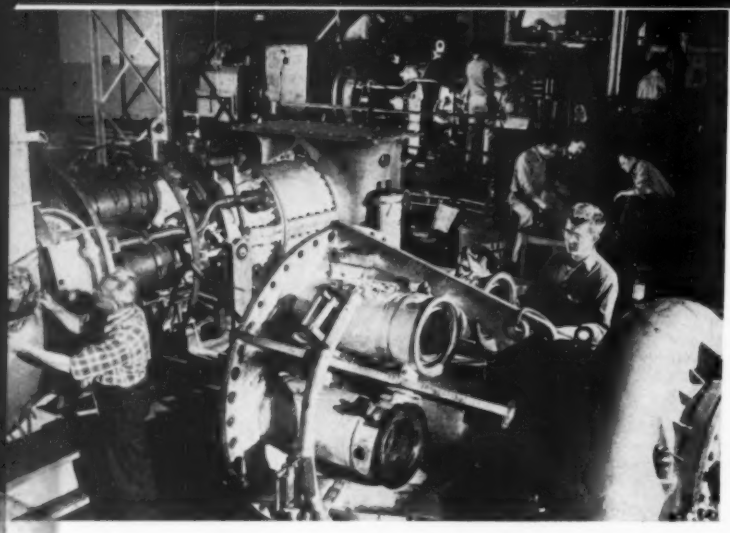


Fig. 1. Gas turbines on test and assembly floor

By
ROY E. BURRIS
and
B. G. HATCH

Gas Turbine Department
General Electric Company

How G. E. Tests Gas Turbines

Unlike the steam turbine, the gas turbine power plant must be assembled and test operated as a whole, including all accessories. Here is how the General Electric Company solved new problems in developing test facilities for a new product

IN THE DEVELOPMENT and manufacture of a new design of prime mover, such as the combustion gas turbine, one of the important technical problems to be considered is the matter of comprehensive tests before shipment. Consideration must be given to new test techniques, adequate instrumentation to secure complete data for engineering design and performance analysis, and flexibility to cope with new and unexpected problems. Space must be assigned and adequate manpower trained in the special techniques required. Consideration must also be given to expansion to meet increased production requirements, and to provide for new designs.

Unlike the steam turbine, which receives its source of energy in the form of steam at a predetermined pressure and temperature, the combustion gas turbine incorporates within its structure the combustion of fuel, the control and metering of this fuel, and the supply of the necessary primary combustion air and secondary cooling air.

Usually none of these components, with the possible exception of control and certain other accessories, are interchangeable between designs. Therefore again, unlike the steam turbine, each gas turbine power plant must be assembled and operated as a whole, including all its accessories. This imposes a severe problem on the manufacturer, since the assembly time of each unit, together with its required auxiliaries and accessories and piping would become a major problem not commensurate with modern production.

In this article it is assumed that the reader is familiar with, and has access to, descriptions of the commercial types of combustion gas turbines. Commercially, three types are in current production by the authors' company, all of the open-cycle design. The first is the 4800-hp simple cycle gas turbine, Fig. 2, intended for a 4500 traction horsepower gas turbine electric locomotive. (Ref. 1; references at end of article) In this design, a 15-stage axial flow compressor delivers 80,000 cu ft of air per minute at approximately six atmospheres pressure directly to a combustion chamber system. Fuel is burned to raise the temperature of this air to approximately 1400 F, where it is passed into a two-stage impulse-type turbine, exhausting directly to atmosphere. No regenerators or heat exchangers are used in this cycle because of space limitations in the locomotive cab. The turbine is designed to use oil as fuel and the power developed by the gas turbine will drive four d-c traction type generators to power the locomotive. The same general design has also been successfully applied to stationary power plants by the use of standard reduction gears and 3600-rpm a-c generators for power generation. (2), (3)

Early Test Stands

In the development of the first gas turbine of this type, intended for locomotive, a test stand was specially designed to simulate the structure of a locomotive. It consisted essentially of two 30 in. I beams mounted on trunnions at either end, which represented the support of the locomotive trucks. The stand was purposely made flexible to obtain as nearly as possible any expected reaction or effect on alignment of the gas turbine with its reduction gears and four d-c generators. This developmental stand was used for more than 700 hr of firing test on the first unit, and was also used for two subsequent gas turbines intended for power plant installation. However, it was not well suited for production testing.

The first of the new-design compound-cycle 5000-kw power generation unit (4) was also tested on a developmental stand, located in the corner of the building near the initial locomotive test stand. This compound cycle gas turbine incorporates two stages of compression, repre-

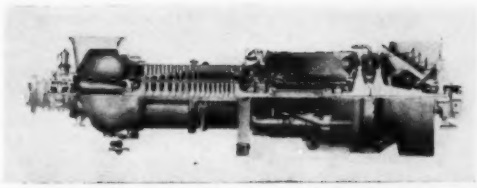


Fig. 2. General Electric 4870-hp turbine for 4800-hp locomotive drive

Fig. 3. Regenerative cycle gas turbine with independent shaft load turbine

sented by a low-pressure compressor driven by a low-pressure turbine, and a high-pressure compressor driven by the load turbine.

The intercoolers and the regenerators are mounted in pairs on either side of the gas turbine. It is obvious that the cycle is too complex for mounting in a locomotive cab, as in the case of the simple-cycle turbine previously described.

Test Problems

The necessary pressurized air ducts, piping, lubricating oil and fuel piping and water cooling would render it almost prohibitive to assemble this type of gas turbine, piece by piece, on a factory test stand before shipment. Actually the first three machines of this type were individually assembled and tested on the developmental test stand before the production test area was developed. Because this test stand was mounted partly on a cast iron factory floor, and partly on a reinforced concrete foundation, it was difficult to hold the component parts in alignment and to prevent leaks in the high-pressure air piping.

The General Electric Co. is at present manufacturing three types of gas turbines: The first is the 4800-hp locomotive power plant previously described, redesigned from the developmental model for repetitive quantity production. This simple-cycle gas turbine is identical with the 3500-kw simple-cycle stationary generating unit. The second is a 5000-kw compound cycle gas turbine with regeneration and intercooling, essentially identical to the developmental models, except for minor redesign. The third is a new design of a 5000-hp regenerative cycle gas turbine (5), primarily intended for mechanical drive applications, but equally suitable for power plant installations when driving a geared a-c generator with direct-connected exciter.

This 5000-hp class of gas turbine, Fig. 3, includes a large outdoor-mounted regenerator which forms the base of the exhaust stack, and therefore requires ducting of high-pressure air from the compressor to the regenerator. This same air, after being heated by the waste heat of the exhaust, is ducted back to the six combustion chambers. A large exhaust duct takes the hot waste gases from

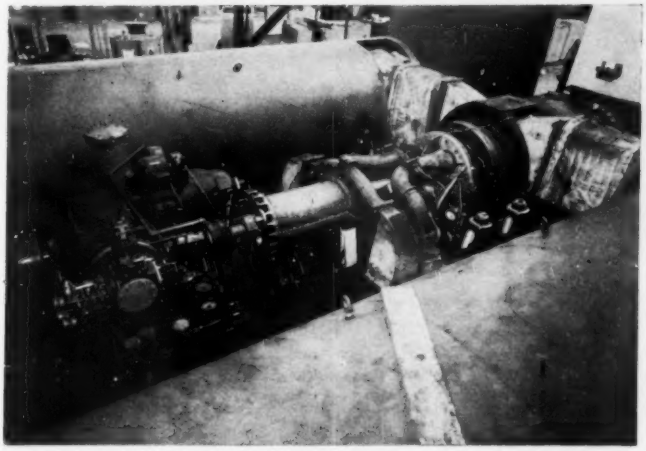


Fig. 4. A General Electric Co. 5000-kw gas turbine power plant on permanent factory test stand showing reduction gear, high-pressure compressor, turbines, and low-pressure compressor, all without lagging

Fig. 5. The first 5000-kw compound cycle gas turbine generator unit on permanent factory test stand

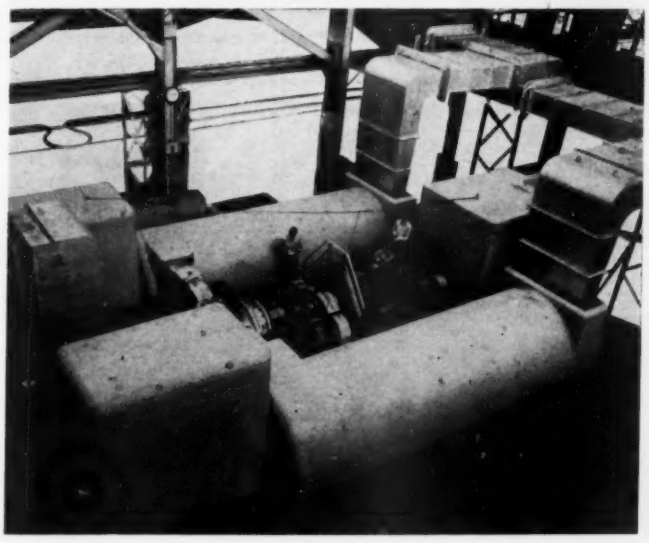


Fig. 6. Permanent factory test stand showing simplicity of mounting arrangement for 4870-hp gas turbine

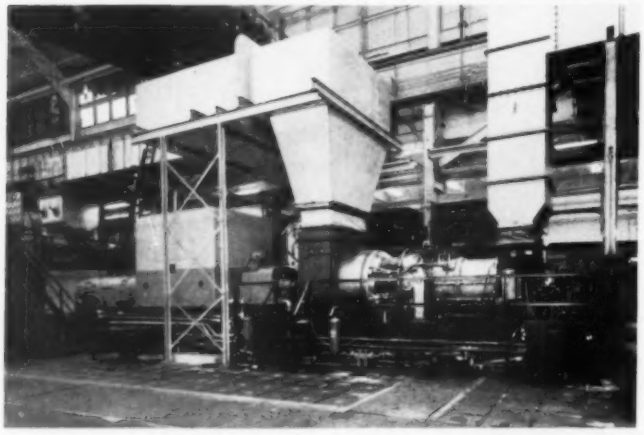


Fig. 7. Production model, 4870-hp gas turbine locomotive power plant on permanent factory test stand

Fig. 8. Test stand for 5000-hp, two-shaft, regenerative cycle gas turbine, just before installation of unit

the exhaust of the gas turbine to the base of the regenerator, where, after heating the compressed air, it is discharged vertically through the stack.

Production Test Area

In entering a planned production program, it was therefore found expedient to abandon the development test stands, and to erect permanent test stands for each class of gas turbine, each stand designed specifically for the cycle intended. Principal details of these are shown in this article.

As the units are factory tested by running them under their own power, it is necessary to have complete starting and supervisory control equipment, Fig. 11, identical to that which will be used in the field installation — on each test stand. In fact, each test stand is essentially a replica of the final installation on customer's foundation, plus the addition of special test equipment, Fig. 9.

For production test purposes, the unit test stands have permanent lubrication systems. This necessitates separate testing of all unit lubrication systems which will be shipped to purchasers, to insure proper piping and operation. These tests are conducted in the main test area adjacent to the test lube oil storage and filtering system.

In addition to testing the complete gas turbine, all accessories must be pre-tested before being assembled with and installed on the gas turbine. To accomplish this, a special enclosed room is provided containing motor driven accessory test stands and all necessary indicating equipment. During this pre-test it is necessary to open parts to make adjustments and settings. To avoid erratic operation which might be caused by dust and dirt normally present in a manufacturing plant, this room is pressurized with filtered air.

Testing of the gas turbines is conducted in the large factory building formerly used in steam turbine manufacture, which has since been converted and equipped with new facilities for gas turbine manufacture.

Unit Test Stands

Each test stand consists of an air filter house, intake and exhaust ducts, foundation blocking, air piping, lubricating system, fuel system, control system, loading system and test instrumentation.

Each filter house contains two calibrated flow nozzles for accurately determining air flow to the unit compressors at existing ambient temperature and pressure conditions. Filters are protected by louvers to prevent clogging from snow during winter months. The inlet ducts and the portion of the filter house back of the flow nozzles are constructed to be as airtight as possible, and are periodically calibrated to determine actual leakage. Filter houses are located on the building roof, Fig. 13, adjacent to the test area.

All ducts are insulated to reduce

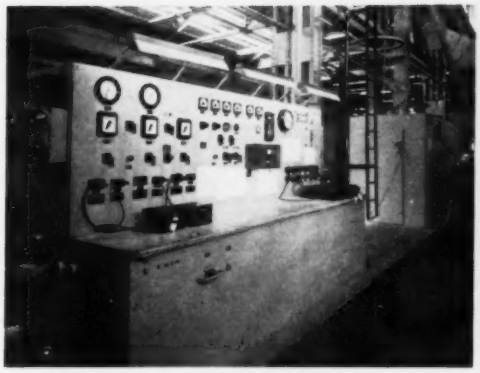


Fig. 9. (Above) 5000-kw gas turbine power plant test stand. Test control area showing load table, panel, auxiliary Cabinetrol and starting resistors

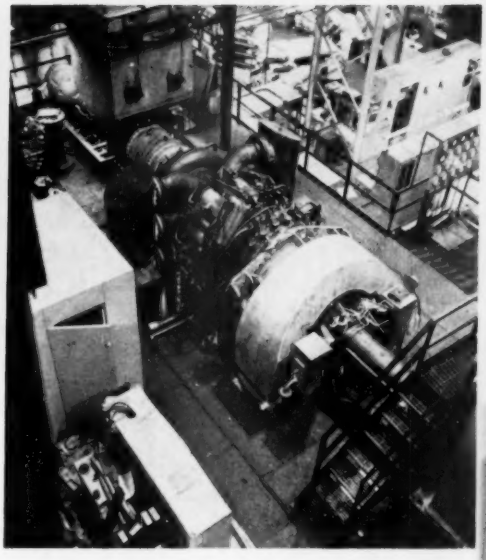


Fig. 10. (At right) First 5000-hp/3500-kw two shaft regenerative cycle gas turbine on test stand without enclosing covers. Note control equipment, top right

the noise level. The exhaust duct for the locomotive test stand is also lagged to keep heat transfer in the test area to a minimum — the locomotive unit exhausts at about 800 F during the summer and the heat given off by about 30 ft of ductwork would make operation rather uncomfortable, as the duct is directly over the control and instrument area.

A transit-leveled cast iron "T" slot section floor is laid in the test area where the stands are located, to simplify anchoring foundation blocks. Foundation blocks are fabricated from steel plate and fastened to the floor with hairpin clamps, doweled in place and grouted in to avoid movement from the forces involved. Every effort possible was made to design the blocking so that natural frequencies would not coincide with running speed of the units.

The 5000-kw compound cycle gas turbine, Fig. 5, consists of two compressors, a turbine, a reduction gear, generator and direct-connected exciter in addition to the stationary intercoolers and regenerators. The test stand for the rotating parts of this unit is made to hold each component, assembled complete with bases. Alignment of components, Fig. 4, with each other and with the reduction gear is done with jack bolts attached to the test stand. Dowel bushings are used when doweling after the line-up is completed. This unit operates at constant speed and varying load as will be encountered in central station service.

The simple cycle locomotive units are assembled on a line-up fixture, and the fully assembled unit is then swung onto the test stand for connecting to the reduction gear and loading generator. Proper footings and foundations are provided on the permanent test stand base, Fig. 6, to permit minimum alignment time with shims, as the locomotive gas turbine does not have its own rigid base, Fig. 7. The stand is equipped with a 4000-kw a-c generator and is practically identical with a stationary power plant installation. The unit is operated at variable speed and load to simulate locomotive operation.

5000-Hp Unit

Because of the number of orders for this new 5000-hp regenerative cycle unit (which also may be rated 3500 kw when used with a power generator), two stands have been provided for this type of unit. One of the test stands, Fig. 8, is complete with reduction gear and 4000-kw a-c

(*Continued on page 120*)

Fig. 11. Test stand for 5000-hp two shaft regenerative cycle gas turbine. Control panel, load table and temperature recording panel at the rear

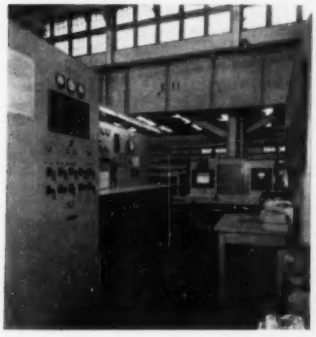


Fig. 12. One of the special manometer boards for making pressure measurements which is erected at each of the permanent gas turbine test stands

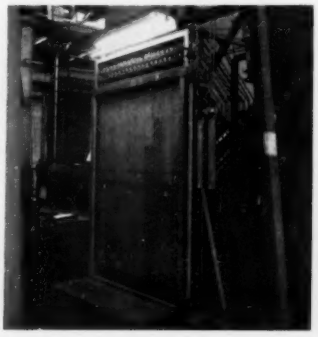


Fig. 13. (L to R) Filter houses for test stands on roof of building. Exhaust stack stand, filter house and exhaust stack stand in process of erection

HOW DO TURBINES GROW?

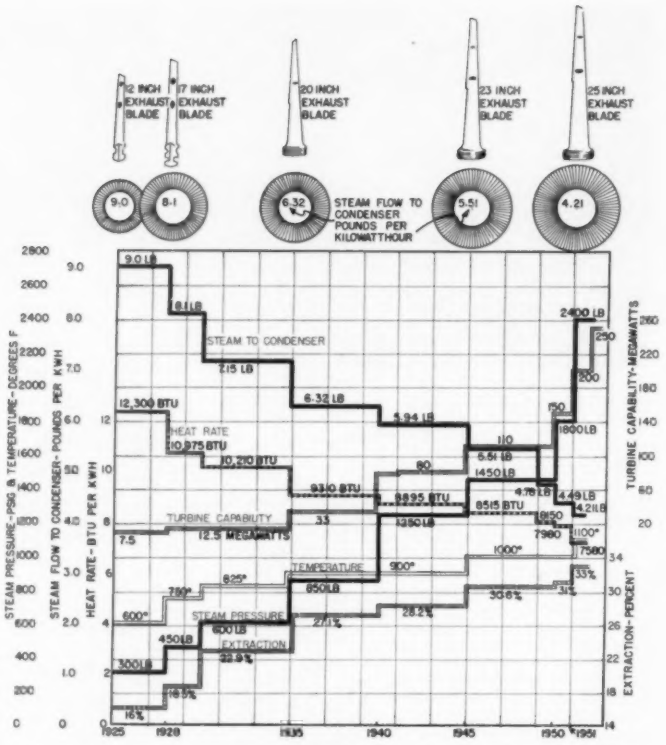
By J. R. CARLSON
Engineering Manager, Steam Division
Westinghouse Electric Corp.

IF IT FOLLOWED the practice of 25 years ago, a 200,000-kw steam turbine would exhaust 900 tons of steam per hr and would be almost literally "as big as a house." Instead, steam to the condenser is but 400 tons, with no increase in leaving loss. This great progress results from higher steam pressures and temperatures, utilization of "size factor," more economical feedwater heaters, and multiple exhausts.

The effect on turbines of higher steam pressures and temperatures obtains well deserved attention. Reduction in steam flow and fuel consumption is usually analyzed carefully to make certain the saving justifies the expense of stronger, more costly turbine parts.

But other advantages accrue from higher operating conditions. Most significant is a reduction in condenser flow greater than the reduction in throttle flow. This means more efficient utilization of steam. It means smaller condensers. Reduction in condenser flow per kw output is important, because exhaust steam flow area for a given set of operating conditions determines economic rating. If all turbines required the same exhaust flow per kw output, larger kw ratings could be built by increasing steam flow exhaust area, by reducing efficiency (increasing leaving loss), or both.

Today's 3600-rpm turbines are built with ratings 25 times larger than those of a quarter of a century ago. But the exhaust steam-flow annulus has not been increased by that amount. In single-flow elements, the annulus has been increased about four-fold.



Answer, of course, is the steady and consistent improvements in turbines and associated equipment coincident with rises in steam pressure and temperature. Increased steam pressure and temperature make more Btu's available for conversion to mechanical work and provide the greatest reduction in throttle and condenser flow — but other factors help. Effect of turbine rating — turbines of larger kw output have better blade proportions, hence better efficiency — improves efficiency as much as 5 per cent and thus reduces throttle and exhaust flow.

Steady Improvement

Higher steam pressures, bringing higher saturation temperatures in the boiler, have led to increased use of feedwater heaters, more steam extracted, and thus marked reduction in exhaust flow. Early turbines rarely had first-stage pressures as high as 200 psia, limiting temperature of feedwater to the boiler to about 350 F. Today first-stage pressures may be as high as 1500 psia, which means it is possible to heat feedwater to around 580 F, if such were economical and practical.

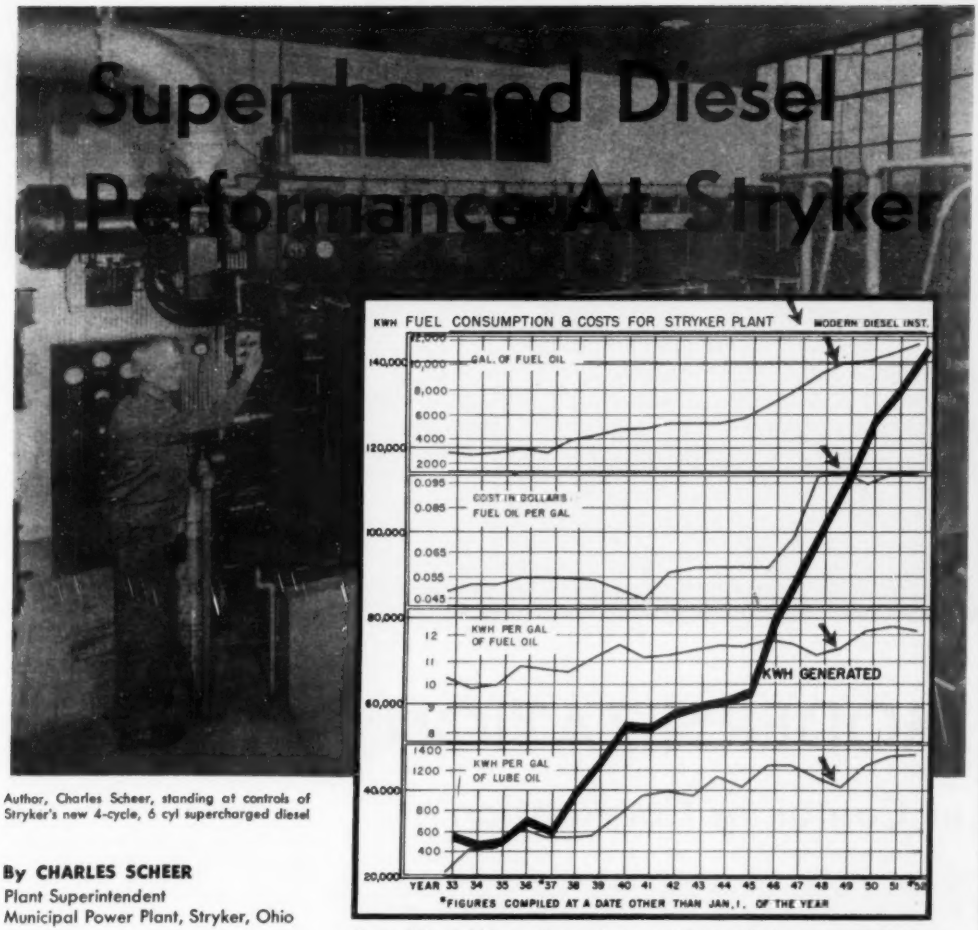
Turbines in the middle 1920's usually had only three stages of feedwater heating, requiring about 15 per cent of throttle flow. Today's turbines may have eight feedwater heaters extracting as much as 33 per cent of throttle flow. Improved feedwater heaters, some of which incorporate desuperheating sections or drain cooling sections, have made it possible to improve thermal efficiency by extracting more steam. The greater the percentage of steam extracted, the greater is the thermal efficiency.

Progress Goes On

All of these factors have combined to reduce exhaust flow per kw output. This has made possible the 200,000-kw single-shaft, 3600-rpm turbine now being designed, and 250,000-kw units now planned. Although gains obtained for each increment of increased steam pressure and temperature are getting smaller, progress will not cease. Steam pressure and temperature will rise to 3000 psig or higher with throttle temperatures of 1150 to 1250 F. These higher pressures will require as many as 10 stages of feedwater heating.

New and larger turbine exhaust end blades now being projected for the future will reduce leaving losses or permit larger rating. This improvement when used in conjunction with two stages of reheat will reduce exhaust steam flow to 3¾ or 3½ lb per kwh. Reduced to a single statement this means more efficient turbine generators.

Supercharged Diesel Performance At Stryker


KWH FUEL CONSUMPTION & COSTS FOR STRYKER PLANT
MODERN DIESEL INST.
GAL. OF FUEL OIL
COST IN DOLLARS FUEL OIL PER GAL
KWH PER GAL OF FUEL OIL
KWH GENERATED
KWH PER GAL OF LUBE OIL
YEAR 33 34 35 36 *37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 *52
*FIGURES COMPILED AT A DATE OTHER THAN JAN. 1. OF THE YEAR

Author, Charles Scheer, standing at controls of Stryker's new 4-cycle, 6 cyl supercharged diesel

Trends of the past 19 years for some fuel and other costs at Stryker are graphically shown

By CHARLES SCHEER
Plant Superintendent
Municipal Power Plant, Stryker, Ohio

CONSTANTLY rising fuel and lube oil costs in the diesel municipal plant of Stryker, O., dictated a decision to take advantage of economies offered by a modern unit with a lower fuel rate. Under test in the first winter of operation, the engine, a 4-cycle, 6-cylinder, 12- by 15-in., supercharged Superior diesel, developing 695 hp at 450 rpm, generated 14.2 kwh per gal of fuel as compared to 11.25 for older units.

Stryker first went into the power business in 1906 when it erected a distribution system and purchased power wholesale from a nearby utility for resale. Operating under this arrangement for 26 years, Stryker finally built a power plant and installed generating equipment.

Initial installation consisted of three 2-cycle diesels with direct-connected generators and exciters, and totaling 326 hp. System load continued to increase: in 1939 a fourth unit of 300 hp was added; and in 1948, the 695-hp unit replaced one of the original 2-cycle engines.

Peak load on the system is approximately 500 kw with an average load of about 325 kw. The new engine immediately took over the load with a marked increase in over-all plant efficiency.

Fuel oil for the diesels is stored in an 18,000-gal tank located underground at the rear of the powerhouse. Motor-driven pumps send the fuel to four day tanks, also underground. From these, engine-driven pumps supply fuel directly to the fuel injection system.

Automatic Lubrication

Lubrication is arranged for continuous automatic operation by pumping oil from nearby 250-gal tanks directly to the engines at about 30 psi. Used oil drains to the engine sump and is then pumped through a filter back to storage tanks. All oil removed from the sump is purified before re-use.

Water cooling system for the new engine consists of a completely enclosed Marlo cooler located in an 18- by 22-ft structure behind the engine. This system automatically adjusts water temperature to 136 F prior to circulating it through the engine. Heat from the engine jacket is used as a heating medium for the City Hall building, next to the power plant. Under this arrangement, jacket water is pumped underground directly to building radiators. All make-up water is drawn from a well and put through a softener.

Exhaust from the Superior engine is piped through the floor and then out to vertical Maxim silencers at the rear of the plant. All exhaust temperatures are carefully measured by pyrometers.

(*Continued on page 126*)

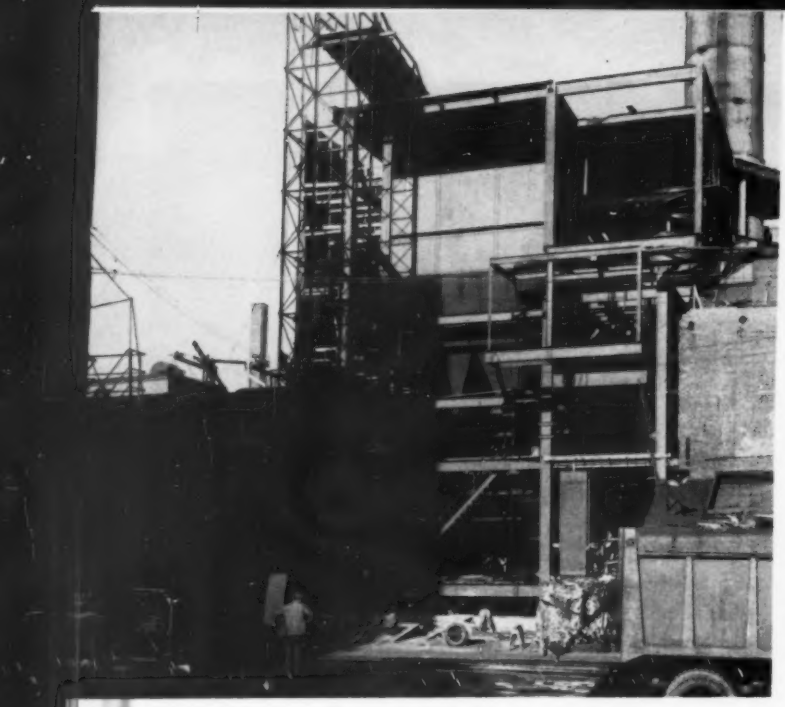


Fig. 1. Extensive changes in company's power plant included erection of new Riley boiler to replace two old 500-hp boilers. Unit generates 110,000 lb of steam per hour at 400 psi, 760 F

MODERNIZATION

at Container Corporation

By R. N. CONGREVE
Engineer in Plant
Container Corporation of America

SINCE 1947 a power modernization* program has been taking place at the Container Corporation of America's Lake Shore Plant. Bounded on the south and east by the Chicago River and on the north by the Ogden Slip, a section of the plant extends out under Chicago's Outer Drive. The power plant originally was similar to that usually found in a medium-sized manufacturing plant supplying its own steam and power, and had been in operation for many years.

In 1945 a survey revealed two important reasons for high power costs: (1) product changes, and (2) fixed steam costs on prime movers such as steam engines. It was agreed that despite the use of heat exchangers and heat savers, a material cost reduction could not be realized. The problem resolved itself into one of proper Btu balance by pressure and temperature.

Main steam generating equipment at this time consisted of two 500-hp, straight tube, sectional header, longitudinal drum, 30,000 lb of steam per hr generators built in 1926 using natural draft, chain grate stokers and equipped with a 192-ft tapering concrete stack; two 367-hp, four drum, bent water tube, water cooled, 30,000 lb of steam per hr boilers built in 1934 with forced draft, Illinois chain grate stokers and a Prat-Daniel 137-ft steel stack with a 3-ft 4-in. Venturi just above the induced draft fan; and 6 boilers of 300-hp, four drum, bent water tube, 15,000 lb of steam per hr, built in 1906 using natural draft, chain grate stokers and equipped with a 197-ft tapered concrete stack. Saturated steam at 160 psi was generated. Figure 2 illustrates steam balance at this time, Fig. 4 shows old firing aisle.

Electric power supply, in addition to that furnished by utilities, was generated by a 1500-kw, 3600-rpm, 480-v, 3-phase, 60-cycle turbine generator installed used in 1929, as shown in Fig. 3. A reconditioned 625-kw machine was installed in 1935 for added capacity.

Process equipment was driven by 3 variable speed 150-hp steam engines and 3 constant speed 175-hp steam engines. Water was supplied by a double-acting, cross-compound steam engine of 4500-gpm capacity; a 10-in. volute pump driven by a steam turbine at 5500-gpm capacity; and a duplex steam unit. An identical duplex unit was used as a fire pump. Air was supplied by a 145-cfm compressor and a 215-cfm compressor.

First step was agreement that existing pressure of 160 psi with 25-psi back pressure was too low for efficient operation in turbine and process steam. Considering existing equip-

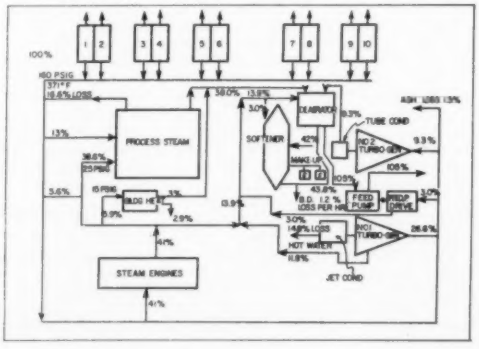


Fig. 2. Original steam balance of plant is shown in diagram. With 100 per cent steam load, losses 42 per cent

* This article is abstracted from a Junior ASME award winning paper by the author entitled, A Power Plant Conversion With Maximum Plant Production, presented April 15, 1952, to the Chicago Section of the ASME.

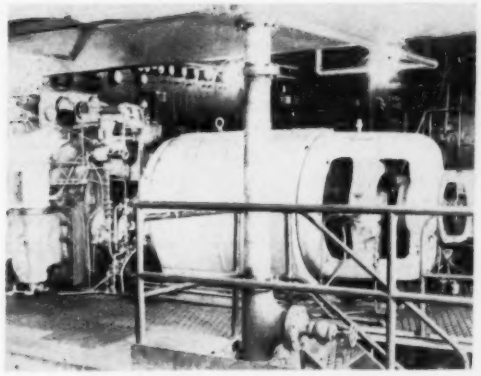


Fig. 3. This 1500-kw Curtiss-type GE turbine generator was installed in 1929, and supplied most of electric power used before the plant modernization

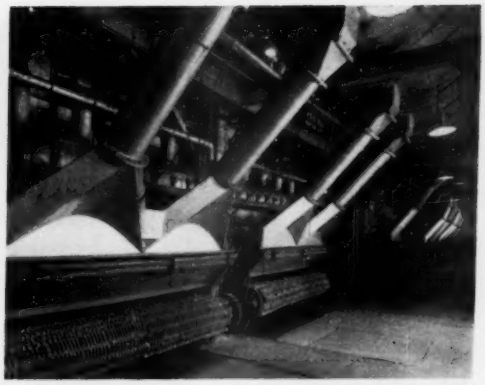


Fig. 4. 1942 photograph shows two 500-hp boilers (left) installed in 1926, two 367-hp boilers built in 1934, and six 300-hp units in service since 1906

ment and with the thought of rebuilding two boilers, it was decided that generating pressure would be changed to 425 psig at 760 F (about 300 F superheat) and a 110,000 lb per hr boiler would be erected on the site of the two 500-hp boilers.

It was then decided to install a new 4000-kw turbine generator at 0.8 pf to increase capacity and balance steam and electric load, shown in Fig. 6. All steam engine drives would be replaced with modern turbine and electric drives to eliminate fixed steam loads, high maintenance costs, and the low back pressure problem.

Methods of supplying sufficient steam and power to keep the plant at full capacity during the conversion program were studied. Steam locomotives, diesel generating units and a naval power plant were ruled out as stop-gap measures for various reasons, and it was agreed to rely on what was made available by public utilities, combined with power produced from equipment not undergoing changes.

First part of the boiler rebuilding job on the two 367-hp units, completed in November 1947, consisted of general brickwork, repairing additional side wall tubes, shortening arches, cleaning inside, replacing forced draft fan rotor, rebuilding ash hoppers, and general external cleaning. Operated at 160 psi with periodical cleaning until September 1949 when the large boiler was completed, the boilers were then converted to 400-psi units with the addition of the economizer and superheater.

After the partial rebuild job on these two boilers, the two old 500-hp boilers were demolished and removed. Water pumps were changed to vertical deep-well pumps and electrified. Process equipment was improved to lower steam rate and reduce losses.

Lineshaft driven units were motorized one by one, while erection of the 110,000 lb per hr boiler was taking place. Temporary utility power was run to various central locations with bus duct and all motors were wired temporarily. This process slowly eliminated all steam engine drives, but at the same time made a balanced power situation very difficult to maintain.

The large boiler went on the line August 22, 1949. Immediately two 300-hp boilers were demolished to prepare the site for installation of the new turbine generator. The turbine was set January 23, 1950 — the generator the next day.

Electrical Work

Turbine and boiler work completed, electrical distribution work was next. Main tie-ins were installed during annual shutdown from the bus duct which had been run to 7 main distribution points. Motorized units were permanently wired. To protect operation of some equipment, two of the seven main distribution points were direct-connected to utility power with an emergency feed back connection at a third point.

Figure 5 shows present steam balance. Many small operating kinks are yet to be discovered and ironed out to obtain maximum efficiency, but many original goals have been met or exceeded by the changes. Coal consumption per unit of product, for example, has been cut nearly one-third — an indication of achievement.

Fig. 5. Present steam balance diagram indicates changes made since rehabilitation began. With 100 per cent steam load, losses are 17.7 per cent

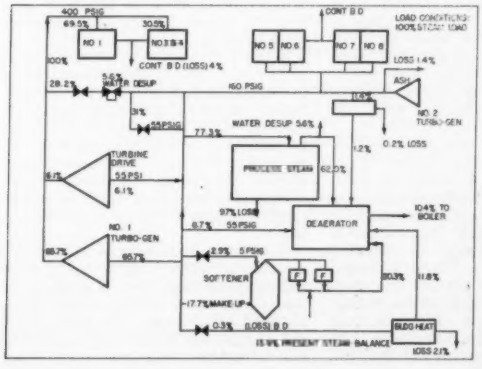
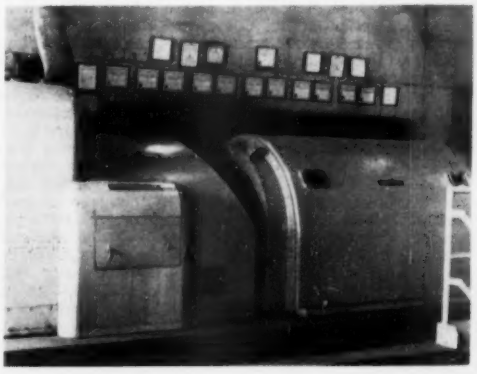


Fig. 6. Westinghouse 4000-kw turbine generator, installed on side occupied by two 300-hp boilers which were scrapped to make way for erection.



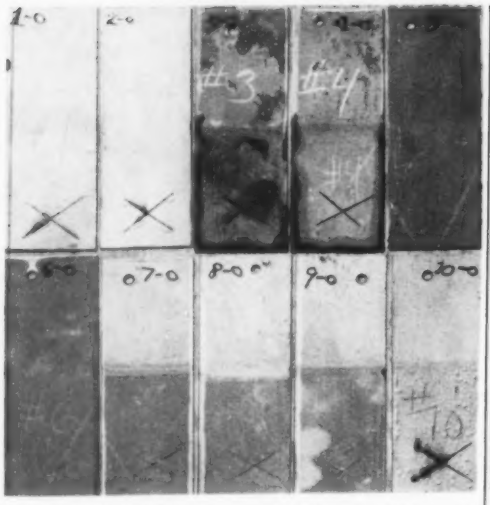


Fig. 1. Metal panels without metal preparation which were similarly exposed

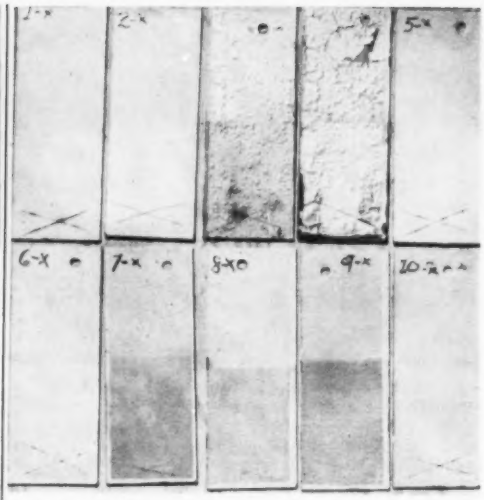


Fig. 2. Panels which were tested by water submersion and humid atmosphere

Test Your Power Plant Paint

By L. G. JONES

You can do your own paint testing and get results in a few days. The author explains the easy method he used to find the best paint to use around his power plant. Here's how —

POWER PLANTS AND UTILITIES are not production users of paints like manufacturers of automobiles, cabinets or other items requiring large quantities of coatings that must be of a very constant grade to meet fixed operating and performance requirements. Spray guns and baking or drying conditions are set up in production plants to meet line and assembly schedules. Colors and other properties must meet inspection demands. Material control specifications lay down the precise requirements and laboratories serve as watch dogs to see that these requirements are met. Failures must not occur after the products have been delivered all over the nation, or in far corners of the world. Both the paint manufacturer and the production user go to elaborate tests and studies, even to Florida atmospheres for long exposures, to procure the right quality of finish paint. Chemists work for months trying to destroy or improve the paint. It is a contentious detailed battle.

The power plant or local utility needs its paint for maintenance only. It repaints its steel power towers, its tanks, holders, and few permanent structures at about 5 year intervals. Other jobs are sudden decisions. The local paint store supplies the few quarts or gallons. Perhaps the neighboring store gets the next order, in the desire to spread the business among as many customers for power or gas as possible. Paint salesmen are usually a problem to the purchasing agent. Each has the finest product and the only way of proving these statements is by trial and error. There are too many types, brands, and salesmen to try out with too little opportunity.

One local utility company decided to settle the question of paints by some simple tests, utilizing the local commercial testing laboratory. Several painting programs were coming up that had sufficient importance in cost and permanence to warrant some prior study. These included painting high steel electric transmission line towers, regulator pit piping, propane tanks, and other outdoor and underground steel surfaces. And the tests had to be quick and fruitful.

In previous tests on particular jobs set up for specific purposes, metal and wood panels were tested in the weatherometer and in pits or spots where the paint was used. The time required was more than permitted and the differences in specimens were not unconditionally resolved. Doubts still existed. A prayer was uttered along with the recommendation. A more drastic and decisive method of testing was desired.

A method was finally adopted that so far has not let them down. It is presented in this article not as a profound or even generally accepted method of testing paints, that should be adopted by the ASA or even by anybody. It gives a mathematical answer like the new giant electronic calculating machines, without equivocation or mumbling. It has worked so far.

The paint to be exemplified in this discussion was primarily to be used for covering steel towers. Due to the relatively small steel surface to be covered with paint on such large structures, the cost of the paint was but a fraction of the cost of the labor

Table I. Example of graphic form which was designed to list the paint properties

Type of Paint ..... Use or Purpose .....
Color ..... Vehicle or Base ..... Pigment .....
Test requested by ..... Charge .....
Type of Panel ..... of Test .....
Makers of Paint ..... Brand ..... No. .....
Test No. ..... Tested by .....
Dried for 48 hours prior to test. Was thick/thin/normal. Brushed/sprayed on smoothly/thickly/thinly with/without addition of thinner; Cover over old surface was: E, VG, G, F, P, VP, B, VB. Aggregates: None, few, some, marked. (Encircle words that apply.)
Test Started ..... Ended ..... By .....

TEST PERIOD DATA

	QUALITY		SUBMERGED							HUMID ATMOSPHERE						
	DAYS		NEW	2	10	20	30	40	50	60	NEW	2	10	20	30	40	50	60
1	FINISH	VG G F P VP B																
2	ROUGHNESS BRUSHMKS.	NONE V SL SOME MKD BAD																
3	GLOSS	VG G F P VP NONE																
4	BRIGHTNESS (CHANGES)	BRIGHT LIGHT DULL DARK																
5	ALUMINUM COLOR (INSERT INITIAL COLOR AND CHANGE)	NO CHG V SL SOME MKD BAD																
6	BOND	G F P NONE																
7	HARDNESS	SOFT CURL G SP BRTLE PDRY.																
8	RUSTING	X-MK EDGE SPOTS NO RUST F B																
9	BLISTERING	NONE FEW SM FEW LG MANY SM MANY LG																
10	GEN. APPEAR.	VG G F P VB																

Table II. The method used to record and evaluate submerged paint panel halves

No.	Item	Corresponding Property	Values
1	Finish	Character and permanence of surface quality.	Very good (VG) to bad (B).
2	Roughness Brushmarks	Lasting smoothness. Change in conspicuousness of brush marks.	None to bad.
3	Gloss	Changes in vehicle or oil base.	Very good to none.
4	Brightness	Maintenance of depth given surface color.	Bright to dark.
5	Color	Changes in color.	No change to bad.
6	Bond	Changes in adherence to surface of metal.	Good to none.
7	Hardness	Changes in curl to knife edge, sponginess, brittleness.	As indicated on form.
8	Rusting	Appearance of rust in the X-mark, edges, spots and final condition.	As indicated on form.
9	Blistering	Osmosis or permeability of film, blistering from any cause.	As indicated.
10	General Appearance	Visual general evaluation of panels at an over-all glance. General reaction.	Very good to very bad.
11	Viscosity	Thickness, thinness of paint in can or on application.	As indicated.
12	Coverage	Concealment of or coverage over colors of panel when painted over.	
13	Aggregates	Number of particles or lumps in paint when first applied.	

Table III. Items of Table II with numerical valuations for grading purposes

			Submerged		Humid Atmosphere	
No.	Property	Factor	Item	Points	Item	Points
1	Finish	new	G	2	G	2
		1st change	P	4	G	2
		days	20	5	—	0
		final	B	6	G	2
		days	60	1	—	0
2	Roughness	new	S	3	S	3
		1st change	M	4	S	3
		days	20	5	—	0
		final	B	5	S	3
		days	50	2	—	0
3	Gloss	new	F	3	F	3
		1st change	P	4	P	4
		days	20	5	20	5
		final	VP	6	VP	6
		days	50	2	50	2
4	Brightness	new	L	2	L	2
		1st change	DU	3	L	2
		days	50	2	—	0
		final	DU	3	L	2
		days	—	0	—	0
5	Color	new	NC	1	NC	1
		1st change	VS	2	VS	2
		days	2	7	10	6
		final	M	4	S	3
		days	50	2	20	5
6	Bond	new	F	2	F	2
		1st change	F	2	F	2
		days	—	0	—	0
		final	F	2	F	2
		days	—	0	—	0
7	Hardness	new	C	1	C	1
		1st change	SB	2	C	1
		days	30	4	—	0
		final	Br	3	C	1
		days	50	2	—	0
8	Rusting	X days	10	6	20	5
		E "	2	7	20	5
		S "	30	4	40	5
		final	B	3	B	3
		days	50	2	60	1
9	Blistering	new	N	1	N	1
		1st change	MS	3	MS	3
		days	2	7	10	6
		final	ML	5	MS	3
		days	60	1	—	0
10	General Appearance	new	G	2	G	2
		1st change	F	3	F	3
		days	10	6	40	3
		final	VB	6	P	4
		days	60	1	60	1
11	Viscosity		thick	2		
12	Brushed		"	2		
13	Thinner		none	—		
14	Coverage		E	1		
15	Aggregates		F	2		
			—	—	—	—
Total items and points			55	165	50	112
Grand totals			105	277		
Points per item				2.64		

Table IV. Final results of the 11 paints tested. Manufacturers' names coded

Rating	Panel Nos.	Paint Identification Firm—No.	No. of Days Tested	Average Points per Property
1	A-4, 5, 6	IV-2	60	1.93
2	A-10, 11, 12	DL-1	60	1.97
3	B-1, 2, 3	BS-1	40	2.49
4	A-1, 2, 3	SU-2	60	2.52
5	B-7, 8, 9	IR-1	40	2.53
6	B-10, 11, 12	TV-1	40	2.59
7	A-7, 8	RU-3	60	2.66
8	A-9	IR-2	60	2.71
9	B-4, 5	DC-1	40	2.96
10	B-6	FB-1	30	3.04
11	A-13	SU-1	60	3.22

in the time required to climb and maneuver among the members of these 150 foot towers. These towers were galvanized but with its spelter roughened and aged by about 4 years of exposure. The paint had to serve as its own combined single ground and finish coat. It must have good bond, corrosion inhibition, permanence of a pleasing color, impermeability to water, continuing ductility, long life.

Based upon our limited past experience and the testing facilities and personnel available, a method was adopted as standard procedure for maintenance paints. All paints submitted for test are given the same tests under identical conditions. The final answers are terms of evaluation numbers that can be compared at any time.

Testing Method

The whole method consists of three steps, as:

1. Suitable small steel panels, 2 x 6 inches, preferably clean hot rolled strip, are brushed and cleaned to be free from oil, grease, rough rust, scale; etc. They are not furnished, pickled or polished. Some surface oxide is desired to better simulate conditions as generally exist and to test the rust inhibitive properties of the coating. Unless otherwise prescribed, each sample is carefully brushed upon all sides, edges and corners of a numbered panel and allowed to dry for 48 hours. Then an X-mark is cut through the paint to expose bright metal on both sides of each end of every panel. These panels are suspended in a flat pan of tap water and the entire assembly placed in an oven constantly maintained at 70 F and 100 per cent relative humidity. This oven serves for other tests, such as concrete curing, etc., so that it is not a special piece of equipment for paint panel testing.

2. A set of graphic forms were designed, one for each panel, illustrated in Table I. It might be well to list the properties of the paint that will ultimately be evaluated.

The properties listed in Table I served for purposes of evaluation. They are simple to evaluate, and require no instruments beyond a knife to check bond and hardness.

The form is made up so that the panels are examined on designated days up to 60. The notations or X's form a curve or graph of the behavior of each paint. A glance at a group of charts would supply a fairly good evaluation of the group.

3. The individual chart forms must be mathematically evaluated for a permanent record. Otherwise the tests must be repeated with each new group of samples. A final single rating number was believed most desirable. Since different paints may excel in any single property, a final evaluation figure must be comprehensive, to include as many properties as possible. The greater the number of entries or sampling items, the less the error in the final average. Single deviations or errors in judgment or interpretation do not too greatly alter the composite analysis, to the undue disadvantage or benefit of any producer, if enough data is taken.

Such a method of compilation is not easy to devise. It is at once subject to criticism. It is arbitrary, purely empirical. However, it is impartial and honest. Once the examiner makes his entries on the charts, the evaluation by a distant "third party" is not influenced by sight, feel or hearing. It is then cold paper work and arithmetic.

Evaluating the Tests

The work of evaluation is performed in this manner. The longer it takes a paint to undergo a change, in terms of days, the better its resistance and the higher its evaluation. We can then rate the days in terms of 1 for 60, 2 for 50, 3 for 40 and down to 7 for a change in 2 days. Vertically, the quality of the property listed diminishes from top to bottom. Under the first property, finish, VG = 1, G = 2, and on to 6 for BAD.

A few deviations occur. Under hardness wherein the angular motion of the knife blade against the paint body produces a curl, powder or sponge, the terms *powdery* and *soft* are of equal undesirability and get a "4" each, against a 1 for the curl. Under *rusting*, checks are placed in the lines where rust is visible, each of the three places giving its rating for the day of observation. The G, F, B give the over-all surface rust condition. The terms of *blistering* are self explanatory.

Space does not permit a full discussion of the deviation of the final evaluation. The sample form serves as a demonstration. The various con ditions under the heading *factor* are *new, first change, days* for this change to take place, *final condition, days* to reach this condition. The points were enumerated above. The halves of the panels which are submerged under water and exposed to the humid atmosphere above the water level were separately examined, recorded and evaluated (Table II).

They came up with a final unit rating value of 2.64. In order to better understand these values, different tests of 16 different makes of paints considered for brushing on steel towers came out like this summary tabulation; with its trade names, paint manufacturer and manufacturers' formula, name and number omitted (Tables III and IV).

The above 11 paints were single coat trials. Six sets of two coat tests were made from selected combinations of the 11 sources. The unit property points for these double coats range from 2.16 to 2.88. Future tests on new paints and sources are to be tied into the lists of standards of paints already tested.

On the basis of these ratings two paints of a given color were selected and a number of transmission lines were painted. The results so far have justified this method of testing. They believed they eliminated the less corrosion resistant samples.

Industrial Plant Tests

This article is presented also for the benefit of the smaller industrial plant whose testing facilities are limited. New paints are always being offered. While there is no doubt that the final test must be the actual coating of some equipment and waiting several years for the results, the method presented supplies a permanent record and an initial means of elimination.

Subsequent articles will discuss reflective properties of paints, heat absorption, color for public relations and other important characteristics of power plant paint.

Kitimat—World's Largest Underground Hydro Plant

THE KITIMAT aluminum development being undertaken by the Aluminum Company of Canada at Kitimat, British Columbia, is an engineering project involving the largest underground power development in the world. It will have a storage reservoir with a capacity exceeded only by Boulder Dam's Lake Mead, the world's greatest capacity impulse type turbines, the highest voltage power cables in service in North America, the largest transmission-line conductors ever fabricated and the world's largest aluminum smelter. The ultimate firm delivery will be 1,670,000 hp and the installed capacity will be 2,240,000 hp.

This new development is being located at Kitimat because cheap water power, from the Nechako-Kemano power source, and cheap transportation are available.

An interesting feature is the fact that the power plant will be constructed underground. When completed it will have 16 vertical, single-runner, four-nozzle impulse turbines, each rated at 140,000 to 150,000 hp at 327 rpm. Space requirements, for the complete development necessitate a chamber over 1000 ft long, 80 ft wide and 135 ft high. A small village will be necessary at the power plant to accommodate operating and maintenance personnel.

Power Engineering's

PRACTICAL ENGINEER and ELECTRICIAN SECTION

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Why Do These Steam Flows Differ by 20%?

What Can He Do About This Hotwell Pump?
Comments by—H. T. Livingston, G. N. Andrews, L. A. Whitney, R. V. Galloway, C. W. Bell, Sr., R. M. Heyl, R. H. Freyberg, E. S. Monroe, A. H. Moulton, W. C. Justice, M. E. Rule, C. F. Bishop, M. Evans, A. M. Leader, A. W. Hider, B. D. Riley, H. P. Morley, and Matt Jones

Will His Pump Lose Suction After Shutdown?—
Comment by R. K. Brown

How To Install Flexible Metal Hose

Flexible metal hose has proved its usefulness in rugged applications varying from laundry equipment to fuel lines for jet engines. However, even the best material can serve its purpose fully only when installed with proper care and attention. Each installation requires careful study to determine the most suitable arrangement that will avoid conditions detrimental to hose life and effective operation. The following suggestions which are based on many years of experience have been compiled for users by the Engineering Department of Titeflex, Inc.

Figs. 1a & b. Sufficient hose length should be provided to avoid sharp bends at fittings. The right length of hose can be determined from a table for that particular metal hose diameter, or it can be calculated from the formula given below

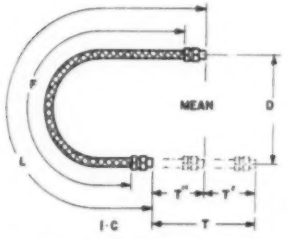


Fig. 1c. Over-all length (L) of hose for a specific installation is determined in 3 steps: 1—Bending distance D, 2—Travel of hose T (T' + T''), 3—Coupling factor C. Length (L) for a hose having no travel and installed at minimum bending distance (D) can be taken directly from table (for single wall, single bronze braid. When hose is subject to travel and is installed at minimum bending distance (D) take the corresponding length (L) from table and add T' or T'' whichever is the larger of the two from "mean" position. To calculate a hose length independently the following formula may be used: Over-all length L = 1¾ D + C + T' (use T' or T'' whichever is the greater)

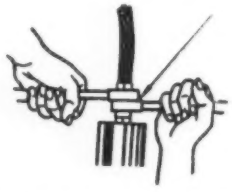


Fig. 2a. Avoid twisting and compressing the hose Right way uses two wrenches like this. Hose is frequently twisted and compressed during installation. These forces deform the braid strands and eventually the hose supporting braid will break

Fig. 2b. Example showing where the braids break

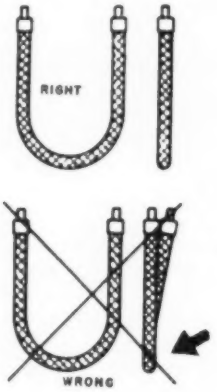


Fig. 3. Install hose with fitting parallel. Use 2 wrenches as shown in Fig. 2a to avoid twisting. Undue strain and twisting which are detrimental to long hose life can be avoided by making certain that flexing of the hose takes place in one plane only

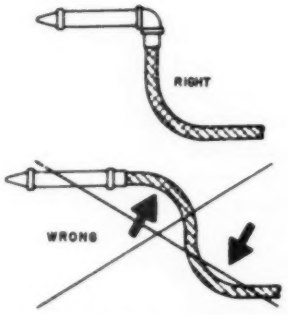


Fig. 4. Avoid "S" bends. By permitting the hose to follow its natural bend, it will last much longer

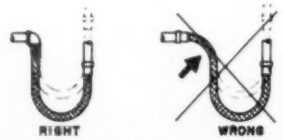


Fig. 5. Avoid double bends. Strain at or near fittings takes years out of the life of the best hose

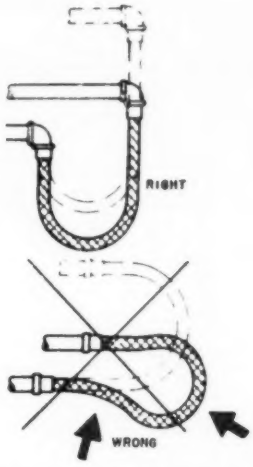


Fig. 6. Use correct bending radius. The bending radius recommended for each hose diameter should not be exceeded or failure will occur

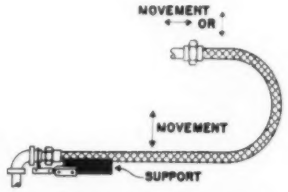


Fig. 7a. Support hose properly. Long runs of hose continually flexing near fittings due to movement or vibratory action should be appropriately supported to prevent failure at these localities (areas)

Fig. 7b. Long runs of straight flexible hose should be strap supported to prevent braid wire creep due to gravitational and vibratory forces

Fig. 7c. In supporting braided hose particularly where the possibility of braid wire chafing exists, proper chafing guards should be installed

Water Treatment Engineering—
Phosphate vs Carbonate Conditioning

By L. W. FITZPATRICK
Chief Engineer
Department of Corrections,
State of Missouri

What's the best method of controlling calcium scale in your steam generating equipment? The author thinks phosphate conditioning may do the job best. He tells why in this article—third in a series

EXTERNAL WATER conditioning removes the bulk of scale-forming salts. However, no external system is as yet sufficiently fool-proof against scale formation without supplementary internal treatment. Residual hardness entering the water cycle rapidly accumulates in a steam boiler through water concentration.

When boiler water is internally treated to make calcium precipitate out as calcium phosphate, it is *phosphate* controlled. Similarly, when soda ash (sodium carbonate) is used as the control agent to make calcium precipitate out as calcium carbonate, it is *carbonate* controlled.

While phosphate control is roughly three times as expensive as carbonate control, it offers added advantages in over-all operation which offset its higher initial cost.

Phosphate is usually preferable to soda ash in removing calcium hardness because soda ash at high temperatures, when uncombined with calcium, breaks down to caustic soda. Excessive soda ash must then be fed to maintain adequate carbonate radical CO_3, at the same time increasing total alkalinity. With carbonate control it is virtually impossible to maintain essential sulfate-alkalinity ratios without high dissolved solids and excess hydroxides, which nullify caustic embrittlement protection.

Phosphates Are Stable

Phosphates being very stable do not decompose easily, and thus maintain non-scale conditions without excessive alkalinity. On the other hand, calcium carbonate, end-product of carbonate control, is more soluble than calcium phosphate; hence, more soluble calcium is always in the boiler affording greater opportunity for the formation of scale.

Calcium phosphate differs from other calcium salts in that it does not grow and interlock to form scale. Instead, a sludge forms. Finely divided and very fluid, this sludge is easily carried by boiler circulation and removed by blowdown. Organic compounds such as tannins, lignin or quebracho are often used with both phosphate and soda ash treatments. These substances generally disperse sludge to prevent settling, but their action cannot be accurately predicted and selection and dosage must be determined by trial and error.

Phosphates generally used in phosphate control are sodium salts — either simple or complex phosphates. Regardless of the type employed, reaction with calcium is identical. The phosphate under heat reverts to trisodium phosphate which reacts with calcium salts to form tricalcium phosphate.

Types of Phosphates

Type of phosphate selected depends upon economics and boiler water alkalinity. High carbonate feedwater hardness favors the use of disodium acid phosphate to lower alkalinity. Trisodium alkaline phosphate, conversely, will assist in holding boiler water to desired alkalinity.

Most commercial sodium phosphate treatments offered today for use up to 2200 psi are blended on a 54 per cent phosphate content, with a 5 per cent solution ranging from 8.0 to 8.2 pH. Generally this is not a single phosphate, but a blend of different phosphates, both acid and alkaline.

Sufficient alkalinity must be maintained with phosphate control because calcium phosphate becomes more soluble at low alkalinities and forms a sticky, adherent sludge. Adequate alkalinity for complete reaction with calcium requires a minimum 9.6 pH in a steaming boiler — roughly equivalent to 10.5 pH at room temperature. P alkalinity (indicated by phenolphthalein) must be greater than one-half M alkalinity (indicated by methyl orange), with at least 200 M alkalinity.

Excess Control

No definite figure has been definitely established for excess phosphate control. Some plants with efficient feedwater hardness control operate with a low 10 to 30 ppm excess. Others with regular feedwater contamination require as high as 70 ppm. As a general rule, 100 ppm is the upper limit since high phosphate content increases the tendency to form magnesium scale. Raising alkalinity instead of phosphate will precipitate magnesium in the more desirable form of an hydroxide; while, if silica is present, it will then combine as magnesium silicate, a fluid sludge easily removed by blowdown.

Calcium phosphate can also scale, usually due to high hardness in make-up water which allows considerable sludge to accumulate in low circulatory portions of the boiler. Once

What Are Phosphates?

PHOSPHATES are salts of a simple reaction between phosphoric acid and an alkali, usually soda ash. Phosphate rock, called *phosphorite*, is mined extensively in South Carolina, Florida, Canada and Spain. This rock is reduced to elemental phosphorus in electric furnaces.

Because pure phosphorus is not soluble in water, it is then burned with an excess of oxygen to form phosphorus pentoxide, P_2O_5. This very soluble compound is easily dissolved in water to form acids.

To neutralize these acids somewhat for commercial use, soda ash is added giving an acid phosphate salt with high phosphate content, or an alkaline phosphate salt with small phosphate content — depending upon the amount of soda ash used, and neutralization of pH by it.

Different pH are required for the use of phosphates in industrial processes. Fertilizers require an acid phosphate; many industrial cleaning compounds are neutral phosphates. Higher pH phosphates are used in detergers, dyestuffs, paint pigments, leather tanning, cattle food supplements and patented medicines.

Over-all demand for fertilizer has caused record phosphate production since World War II with a consequent sharp reduction in price.

When dissolved in hard water, phosphates react with calcium and magnesium salts and precipitate them as insoluble salts. Buffered phosphate alkalinity is then free to act in its detergent capacity. This alkalinity is actually much like a reservoir which is released in harmless dribbles when previously released alkalinity has been consumed in the chemical reaction. This delayed buffering action gives the effectiveness of caustic soda without its corrosive action.

In this manner, precipitated and insoluble salts, oils, fats, dirt and grime are released from surfaces to which they cling and float away, remaining in the solution which is then released from the boiler through regular blowdown schedules.

Table shows reactions which take place when phosphate or carbonate controllers are used to treat calcium scale. Figures in parentheses are respectively: per cent of phosphate, per cent solution, and pH

Reaction of phosphates . . .						
Trisodium phosphate (38.5%, 1%, 12.0) $2\ Na_3PO_4$	+ Calcium sulfate $3\ CaSO_4$		= Calcium phosphate $Ca_3(PO_4)_2$	+ Sodium sulfate $3\ Na_2SO_4$		
Disodium phosphate (48%, 1%, 8.9) $2\ Na_2HPO_4$	+ Calcium sulfate $3\ CaSO_4$	+ Sodium hydroxide $2\ NaOH$	= Calcium phosphate $Ca_3(PO_4)_2$	+ Sodium sulfate $3\ Na_2SO_4$	+ Water	$2\ H_2O$
Monosodium phosphate (58.5%, 1%, 4.6) $2\ NaH_2PO_4$	+ Calcium sulfate $3\ CaSO_4$	+ Sodium hydroxide $4\ NaOH$	= Calcium phosphate $Ca_3(PO_4)_2$	+ Sodium sulfate $3\ Na_2SO_4$	+ Water	$4\ H_2O$
Phosphoric acid (54%, 75%, —) $2\ H_3PO_4$	+ Calcium sulfate $3\ CaSO_4$	+ Sodium hydroxide $6\ NaOH$	= Calcium phosphate $Ca_3(PO_4)_2$	+ Sodium sulfate $3\ Na_2SO_4$	+ Water	$6\ H_2O$
Sodium Metaphosphate (67%, —, —) $NaPO_3$	+ Water H_2O	+ Heat Δ	= Monosodium phosphate NaH_2PO_4			
Sodium Metaphosphate (67%, —, —) $NaPO_3$	+ Calcium sulfate $3\ CaSO_4$	+ Sodium hydroxide $4\ NaOH$	= Calcium phosphate $Ca_3(PO_4)_2$	+ Sodium sulfate $3\ Na_2SO_4$	+ Water	$4\ H_2O$
Reaction of carbonates . . .						
Sodium carbonate Na_2CO_3	+ Calcium sulfate $CaSO_4$		= Calcium carbonate $CaCO_3$	+ Sodium sulfate Na_2SO_4		

formed, phosphates will not remove it and chemical or turbine cleaning is the sole cleaning method.

Phosphates remove old scale, but this requires careful control with excess phosphate held to 20 ppm. Carbonate and sulfate scales respond quickly, but silicate scales are very slow in withdrawal.

Generally, scales containing an appreciable amount of calcium will react with phosphate to form calcium phosphate sludge. Phosphate will also react with scale compounds containing other substances in addition to calcium. Disintegration of the calcium portion breaks up the entire scale.

Since any steam boiler is actually a high-temperature hot-process softner, low hardness in makeup water will substantially reduce precipitation and sludge with resultant blowdown.

Combining Rate of Calcium to Phosphate

CALCIUM combines with phosphate in the ratio of 120.24 to 189.96 (from atomic weights of calcium and phosphate radical as combined) to form tricalcium orthophosphate, better known as calcium phosphate, $Ca_3(PO_4)_2$.

Therefore, approximately 1.58 lb of actual phosphate is required to precipitate each 1 lb of calcium hardness. For example, if monosodium phosphate (NaH_2PO_4), which is only 58.5 per cent actual phosphate, were used for controlling scale about 2.70 lb would be required for each 1 lb of calcium hardness.

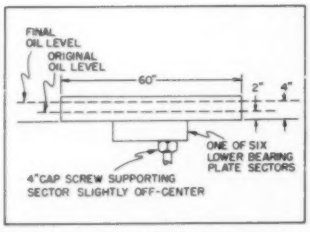
The Case of the Bearing Failure

By H. B. McDERMID

AT A LARGE hydroelectric power plant serious trouble developed in the vertical thrust bearing of the first of 15 large units. The generator stator of the first unit was 32 ft in diameter, weighed 160 tons; the rotor weighed 118 tons and was 28 ft in diameter; shaft was 2 ft in diameter; the thrust bearing tread plates were 5 ft in diameter; supporting what was then heaviest load ever put on a thrust bearing — 270 tons of turbine runner on the lower end of the shaft.

Trouble in that bearing was a matter of real importance. The bearing was lubricated by a reservoir of oil, the surface of which covered the working face of the tread plates by a full 2 in. When filled to the top of the 2-in. vertical overflow pipe, the reservoir had a capacity of 250 gal. A small auxiliary reservoir and circulating pump constantly maintained bearing oil level at the top of the overflow pipe. It didn't seem likely that the trouble-spot was in the lubricating system.

Yet, during the course of the unit's first-day run, bearing oil temperature kept creeping up and failed to level off. After about 15 hr of steady operation, babbitt metal of the lower tread



Raising the surface of the lubricating oil 2 in. stopped the vertical thrust bearing from failing

plates failed and forced a shut down for repairs.

Designer of the bearing had supervised every detail of the installation. He had successfully designed and installed several bearings supporting 220 tons in the past. Consequently, it seemed to be a simple case where bearing metal simply could not take it.

It took two weeks for the crew to replace the bearing plates using high-grade tin babbitt, and to clean bearing surfaces of all grit deposited during the first failure. Every care possible was taken to assure success. When the unit was started again, the results were exactly the same — a slow build-up of temperature of the bearing oil and failure of the bearing metal after about 15 hr.

Next, several different kinds of bearing metal and all sorts of babbitt metal were tried. Finally, as one last desperate measure, a set of fiber-faced plates was used. All failed and each required a two-week shut down for replacement. By this time the designer was a nervous wreck, but he stuck to the job.

Just as the crew was nearly ready for another trial, the designer stared fixedly at the overflow pipe. All at once he grabbed a pipe wrench and replaced that overflow pipe with one 2 in. longer, so the oil's surface was then 4 in. above the working faces of the tread plates, as shown. When the unit was started, the bearing behaved properly, and kept on doing so.

Once the cause of the trouble was determined, the solution was simple. The big tread plates had so much centrifugal action that they threw oil up against the surrounding casing with enough force to rob the working faces of lubrication. The mixture of frothy air bubbles in the inner portion of the plates was not sufficient lubrication for the load to be supported.

Seven more bearings were later installed in the revised way, but not one gave the faintest hint of trouble. However, after the first was successfully installed, the designer went to the hospital for a week's rest before tackling the second.

Tight Compressed Air Lines Save Power Dollars

TABLE SHOWING COST OF AIR LINE LEAKS

Size of Opening (Inches)	Air Lost (cu ft per month at 100 psig based on nozzle coefficient of 0.65)	Cost of Air Lost Dollars per month ($0.07 per 1000 cu ft)
3/8	6,571,390	467.03
1/4	2,920,840	204.46
1/8	740,210	51.81
1/16	182,272	12.75
1/32	45,508	3.19

COMPRESSED AIR, as emphasized by its increased use, has proved itself among the foremost production power media.

Maximum benefits are being obtained by those who keep a close vigilance over their air systems. Conversely, where reasonable maintenance is not conducted, a loss in production and dollars is experienced.

One of the greatest production robbers is low pressure.

If the pressure at a pneumatic tool falls from 90 psig to 70 psig, it has been found that production output of that tool may drop as much as 35 per cent. Somewhat more specific is the case of the air motors which are used extensively to power air tools and devices. Air motors offer more horsepower per unit weight than other comparable power sources. Because compressed air systems in most plants utilize pressures between 90 and 110 psig, air motors are designed to operate within those working pressures. An air motor, built to operate at 90 psig, however, will lose 25 per cent of its capacity if line losses in delivering air drop the pressure to 70 psig.

First inclination when air pressures drop may be to place the blame on insufficient compressor capacity. A check of the air distribution system, first, may save the cost of new compressor equipment.

One of the principal causes of low-air pressure are leaks in the distribution system.

Checking the air distribution system for leaks is a relatively simple matter. Results have proved that the most likely location of small leaks are around valve stems, hose connections, unions, drains, home-made blow guns, and lines leading to inoperative tools. Of course, the entire system should be checked with particular attention to the above and to lines which are subjected to unusually rugged treatment.

Inspections should be made monthly.

Plant maintenance departments have come up with many simple and rather unique ways to check leaks. Most frequently used are the lighted candle or the solution of soapy water which is brushed around suspected areas. One manufacturer puts essence of peppermint into the air system. Detection of the slightest leak is by odor. Still another method, rather ingenious, is the use of what heretofore may have been considered nothing more than a youngster's toy. A small siren-like whistle, activated by air flow, is passed over the lines, a siren noise indicating a leak. Regardless of what method is adopted, when leaks are found, patch them immediately.

Some of the leaks may be very small, appearing trivial in themselves. But such leaks may be numerous and have a high accumulative effect. Actually, these leaks spell a very definite dollar loss as shown in the table.

This dollar and cents wastage more than justifies scheduled maintenance of air distribution systems.

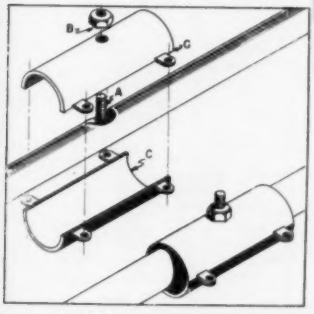
Couple this dollar savings to the increased productive output of the pneumatic tools and it is easy to see that it pays to keep the air lines tight.

A quick check with a hypodermic needle-gage device indicates the pressure received by the tool (hole made by the needle is self-closing). Frequently the cause is a leaky distribution system which should be inspected and made tight. Plants have found that scheduled inspection pays sizeable dividends

Out! Damned Dent

By W. E. WARNER

COPPER PIPE or tubing used for steam or lubricating oil needs to be free from any obstruction. Dents or flattened spots reduce pipe carrying capacity and form handy hat-racks for impurities. These troublesome



Simple method of removing dents from copper pipe

dents can be removed easily. In the sketch, C is a former, fitting over the dented area. A is a threaded copper rod, tinned at the extreme end and soldered to the dent. When the nut, B, is tightened — out comes the dent.

Steam for Rent

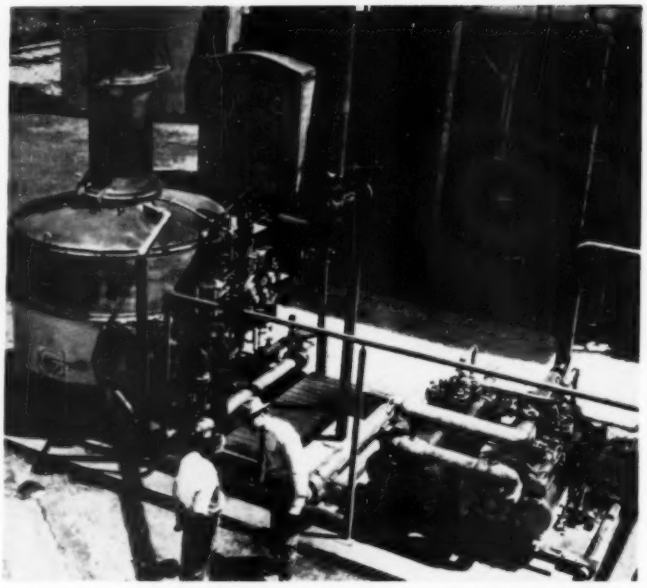
CONFRONTED with the problem of getting enough process steam to maintain production while each of their three boilers went off the line for repairs, General Tire and Rubber Company's Baytown, Texas, plant *rented* a package steam generator.

A concrete base was poured and the next day the complete steam generator was shipped on one truck by the Texsteam Corp. The unit, first Vapor-Clarkson steam generator ever rented, was unloaded, installed, piped-up and on the line in few hours.

Gas fired, the unit is now producing 22,000 lb of steam per hr at 165 psi, day and night. Although only about one-fifth the size of the plant's regular boilers, the package unit produces nearly as much steam per hour.

No additional personnel were needed, since automatic controls take over after the unit is started. Ordinarily, the plant would have needed three more firemen, one for each shift, if three regular 9,000 lb per hr, oil fired boilers had been installed.

Intending to rent the unit for 4 months, General Tire decided to assure adequate protection against shutdown and recently purchased the steam generator.



From this package unit 22,000 lb of steam per hr keeps production up during boiler overhaul at Baytown

"We'll have that machine ready, Chief, soon as we figure out where this goes."

Microwaves in Operation

MID-VALLEY PIPELINE COMPANY, Longview, Texas, has been operating and maintaining a microwave communications system that serves a 1000 mile, Texas-to-Ohio crude oil pipeline. C. B. Lester, chief engineer and C. A. Compton, chief communications engineer for this company, have compiled considerable data from their experiences with this method of pipeline control. Also, they have formed some very definite opinions and have, as a result, drawn up eight recommendations which it would be wise for any other prospective operators to look over carefully. These recommendations are included in a joint paper these men prepared for the Petroleum Industry Electrical Associations' Annual Convention in Tulsa, Okla., and at the Annual Region 4 Meeting of the National Petroleum Radio Frequency Co-ordinating Association, which were both held earlier this year.

First, they say, use hermetically-sealed relays in all positions. It will cost more, but you'll make it back in service calls. Next, oversimplify, if necessary, the a-c transfer equipment. Use all hermetically-sealed relays for control, vacuum-sealed mercury relays for transfer.

Third, if the safety department will allow it, use an LPG engine instead of a gasoline engine on the standby set. An LPG tank will run an engine for a long time and water doesn't get in the tank. Also, don't pipe the crankcase so it can be accidentally

drained. This is disastrous . . . and it happens.

Fifth, use meter service protectors on entrances, right at the entrance cap. Remember, the tower is the biggest lightning rod in the country!

Insist upon good sensing relays. The system depends on these relays to switch over to the standby RF equipment.

Seventh, stay off long rural lines. Pay more and get a better circuit if possible. Seventeen outages in one 24-hour period were experienced at one station; the m-g set never even cooled down.

And lastly, get a constant voltage transformer that's too big.

PRACTICAL HINTS AND KINKS

How about the gadget you made or the trick you used to do your job better? Write us about it. Send a sketch too. You will be paid well for contributions.

Handy Indicators

By L. W. FITZPATRICK

Installation of a numbered disk behind conventional pilot lamps saves many trips for the plant electricians. When motor breaker trips, number in pilot lamp then shows correct starter and breaker to reset. With different voltage panels, corresponding colors can be used in pilot jewel which will identify circuit breaker panel-board door and motor starter locations.

Welder Uses Magnet

By A. B. SMITH

Handy tool for the pipe welder is a magnet. It quickly removes slag from mitre and saddle cuts in pipes. Newer type Alnico magnets with their stronger capacity are easily inserted into the smallest pipe opening.

Polishing Small Holes

By F. E. RILEY

SMALL DIAMETER holes in machine parts can be polished or enlarged with the simple tool shown. Ordinary split cotter pin serves as a bit around which emery cloth is wrapped to form a sanding drum.

One end of the emery cloth is anchored to the pin by inserting it between legs of the pin. It is then wrapped around the pin until the diameter approaches that of the hole to be polished. Outer end of the emery cloth can be held in place with a few spots of quick-drying glue for permanent use. When the outer turn of abrasive has lost its cutting power, a complete turn can be unwound and cut off exposing a fresh surface of smaller diameter.

For temporary use, outer end of the abrasive may remain unfastened, but care should be taken to wrap it around the cotter pin in the opposite direction to that of the drill spindle rotation. This tends to tighten the strip instead of unwrapping it. Hole polishing tools like these are very useful when employed in portable electric drills.

Emery cloth wrapped around ordinary cotter pin makes useful drill bit for polishing small holes

How to Use Wrenches

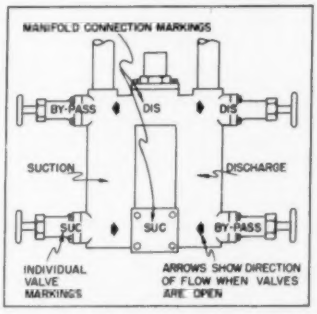
A WRENCH IS a simple tool yet its very simplicity has resulted in most men believing that its correct handling is an automatic and natural human function. This is not so and the cost of man's ignorance has ranged from barked knuckles to actual loss of life. Here are a few simple rules to follow when using wrenches, to help eliminate accidents.

1. Be sure any wrench is fully and squarely seated before pulling.
2. When using a solid (non-adjustable wrench) be sure to select the correct size opening for the nut and bolt accommodated. A partial grip often results in accidents.
3. Do not pack shims between the nut and wrench jaw.
4. Don't expect open-end wrenches to be safe for hard pulls on worn or rounded hex nuts.
5. Do not use open-end wrenches with badly chewed, worn or spread openings — particularly on hex nuts.
6. Think before you push on a wrench. In most cases it is safer to pull. Pull straight to avoid side strain or "cramping" of the wrench.
7. Make sure your footing is good, and your hands dry, before you pull.
8. Never attempt to loosen or tighten a nut on moving machinery.
9. Don't interlock the jaws of two-open-end wrenches to increase their leverage. You're risking serious injury.
10. The application of hammer blows as a substitute for leverage is bad practice (unless you use a striking-face box wrench).
11. When operating an open-end wrench in close quarters, "flopping" it upside down between swings permits continuous rotation of the nut in the least possible space.
12. Any heating or re-hardening of wrenches should be avoided.
13. For greatest strength in adjustable and monkey wrenches, pull on the side of the wrench carrying the fixed jaw.
14. Exercise extreme caution when using any adjustable wrench in a risky pulling position.
15. Never use a wrench as a hammer.
16. Always use a wrench strong enough for the job.

Ammonia Compressor Manifold

By THOMAS TRAIL

BY LETTERING the individual valves of the suction and discharge of an ammonia compressor, as shown, identification of the valves to be used for various operations will be simplified.



Drawing showing how to mark compressor manifold

The additional markings are intended to simplify the understanding of the manifold internal connections, a matter often misunderstood.

Crank Case Oil Level

OIL LEVEL in an engine crankcase should be kept at a reasonably constant level. In some cases this is difficult because the level cannot be determined accurately because the oil foams. This characteristic is influenced somewhat by the oil itself but is usually the result of a poor installation. Occasionally baffles are arranged so that oil flow to the pump is retarded and the pump suction pipe takes air. This air mixes with the oil and foam results. This trouble can usually be corrected by removing or lowering the baffle, by using a lighter oil or by changing the oil level. In one case

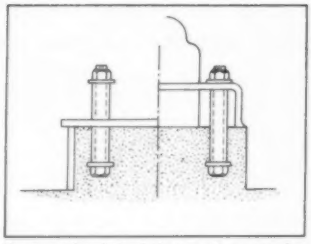
the difficulty was corrected by changing the pressure relief connection. The overflow from the relief valve had been discharging directly at the pump suction and carried air bubbles down into the main body of the oil and these were drawn into the suction of the pump.

Foundation Bolts

By C. A. LEE

IT SEEMS to be assumed that engineers in general understand how to set foundation bolts as there is next to nothing printed in the several more popular handbooks.*

Such bolts are occasionally set with pipe sleeves but there is some disagreement as to the reason for such sleeves. Sleeves do permit a slight jiggling of bolts which could allow for minor inaccuracies in the setting. However, their real value is in making it possible to increase accuracy in the original setting.



How to set foundation bolts true, using a template

Foundation bolts should be set by template. Such templates are ordinarily made of 1 in. lumber long enough to span the pier and be nailed to the formwork. The bolts are assembled with template and the nuts made tight using the sleeves as spacers to make a rigid assembly. When required projection above pier is appreciable, short spacers above template are required as shown in sketch. Handled this way, bolts are not only on correct centers, but are in each case set square with top of pier (i.e., not on a slant).

These remarks are not intended to make an engineer competent to set very heavy and important machinery with multiple hold-down bolts. Years of experience are sometimes required for that, but not for pumps, compressors, crushers and similar pieces of equipment ordinarily encountered. For such, the above should suffice in the easy attainment of a practical degree of accuracy.

* Marks, Kent and Perry.

Questions and Answers

Your fellow engineers will answer your power engineering questions. You answer theirs, get paid well. Simple? Effective? Why don't you try it?

Question No. 501

Why Do These Steam Flows Differ by 20%?

WE HAVE RECORDING and integrating steam flow meters in the main steam lines from five boilers between the boilers and a common header into which all five boilers discharge. All distribution lines from this header are also metered (a total of five main distribution meters) with orifice locations varying in distance from the header, the farthest orifice being approximately 1000 ft away.

Our problem is that we cannot get reasonable agreement between the total steam metered into the header and the total metered out to the departments. The total *metered in* runs from 15 per cent to 20 per cent more than the total *metered out*. The percentage discrepancy varies only a little with variations in plant load.

All the meters have been checked for proper specification and installation, and for operating condition. Integrator totals have been checked by planimetering the charts. Distribution meters have been checked against boiler meters, singly and in various combinations, by manipulation of the load, but the discrepancy remains!

In our opinion, the only discrepancy between the two sets of meters should be that due to condensation in the lines and it should not run more than 5 per cent at most, since all lines are well insulated.

Are we wrong in assuming that the discrepancy between the two sets of meters is too large? If not, what is our trouble?

Lawrenceburg, Ky. M. J. H.

Answer No. 497

What Can He Do About This Hotwell Pump?

IN THE AUGUST issue, M.P. showed by the accompanying sketch how his hotwell pump is installed. He said that, as the hotwell level goes down, the pump cavitates and steam binds because it doesn't have enough net positive suction head.

The pump and hotwell were installed in the power plant basement. Condensate from processes at 190 to 200 F returns to the hotwell and the pump delivers the condensate to a deaerating heater. Condensate is very clean and makes very fine boiler feedwater.

His problem is this: He cannot raise the hotwell because that would entail very expensive changes in condensate return piping. He cannot lower the pump because, for various reasons, he can't go down into the building foundations.

He is told that his condensate at 200 F is coming back too hot, but he doesn't believe that because he sees many other plants handling 200-F condensate successfully.

What can he do to get that hotwell pump out of the squeeze it's in?

Well, the brethren certainly rallied 'round to help out on this one. Many of the answers suggest the same relatively simple solution. Others bring up some different points. All this certainly should show one or more ways to get out of this jam.

Suggests Vertical Shaft Pump

FIRST, simplest and least expensive solution to M.P.'s problem is to maintain a certain minimum head of water in the hotwell. This head should be determined experimentally. A float-controlled by-pass valve should be installed on the pump discharge so that when the minimum head is reached the discharge will lead back to the hotwell.

One objection to this method is that by keeping the hotwell so nearly full there will be considerable heat loss by radiation from hotwell walls and by conduction along the floor and to the ground.

A second plan will permit pumping the hotwell nearly empty. Install a vertical shaft pump, as shown in the sketch, in a circular pit. This will lower pump intake sufficiently to maintain a positive suction head. Control equipment will be needed for this installation also. M.P. would probably need the same system as above to maintain a minimum water level.

Los Angeles, Calif. H. T. LIVINGSTON

Andrews Lists Alternatives

THERE ARE several simple answers to M.P.'s problem not ruled out by given facts.

(1) Continue to operate as is (not impossible).

(2) Divert some bearing water from turbines, fans, pumps, etc., into hotwell to cool contents. This may save water now going to waste.

(3) Divert cold makeup into hotwell.

(4) Install throttling level control valve in pump discharge to maintain necessary level.

(5) Increase height of hotwell walls if necessary, and control level as above. The facts do not indicate insufficient pump capacity.

Roxana, Ill. G. N. ANDREWS

Add Makeup at Hotwell

CONDENSATE of 200 F is somewhat high to return to the hotwell, but M.P. should be able to handle it satisfactorily, providing his hotwell pump is large enough.

BRIDGEPORT BRASS COMPANY
CONDENSER AND HEAT EXCHANGER TUBE EDITION
COPPER ALLOY BULLETIN
"Bridgeport" MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND. — IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL

Hundreds of combinations of different metals are possible in the manufacture of Duplex tubes.

Duplex Tubing Handles Corrosive Products in the Petrochemical Field

The corrosion problem continues to become more complicated as new chemicals are added to the long and growing line of petroleum products. Tubing for conveying liquids and gases; for transferring heat; and for condensing gases must withstand the action of many types of cooling waters; sulfides, chlorides, ammonia, carbon dioxide, solvents, etc. Of the above, water for cooling purposes or when it is a contaminant of the product, is by far the greatest corrosion offender. Copper-base alloys are best suited to resist water corrosion.

Sea water is more corrosive than fresh water. Pollution from factory wastes and sewage complicates matters. Sometimes it makes corrosion worse – rarely is it beneficial. Which metal or combination of metals should be specified for tubing?

Duplex Tubing for Hydrogen Sulfide Corrosion

One of the most troublesome problems deals with corrosion of heat exchanger or condenser tubing which is attacked simultaneously inside and outside by two entirely different types of corrosive media.

A refinery tried steel tubing for cooling propane gas containing an appreciable amount of hydrogen sulfide and some ammonia added to neutralize acidic constituents. It was found necessary to retube the heat exchangers every one or two years due to tube failure on the river water side. When red brass was used, it failed from the gas side. Replacement of the straight steel or red brass tubes with Duplex tubes—low carbon steel to the gases and red brass to the water side – resulted in an average life ranging from 6 to 10 years.

A similar condition involving longer chain hydrocarbons, with a higher concentration of hydrogen sulfide and ammonia as an acid neutralizer, was improved by the use of the same combination of metals in the Duplex Tubing. In different stages where gases entered at temperatures of 200° F. to 120° F., Duplex made up of a low carbon steel tube lined with red brass was found very satisfactory.

In another application, gas from a caustic liquor that had been used to strip hydrogen sulfide and other materials from a stream of hydrocarbon gases, has been successfully handled by the same combination—steel to the hydrogen sulfide and red brass to the cooling waters. Amines used for gas stripping have also been satisfactorily handled with steel/copper duplex tubes.

Lube Oil Coolers and Gas Coolers

Duplex tubes of aluminum to the oil side and copper to the cooling water side are finding increased application in oil coolers used either in manufacturing lubricating oils or in water cooling of lubricating oils from turbines, motors, etc.

In some services, stainless steel tubes have failed from trans-crystalline stress corrosion cracking, with certain types of cooling waters. Where stress corrosion cracking of stainless steel has occurred stainless steel tubes clad or lined with copper alloy have been successfully used. Stainless steel clad copper tubes are also being used to withstand corrosion and erosion by impinging high velocity vapors.

Inter and after coolers handling various compressed gases, often present a dual corrosion problem that cannot readily be handled by a single-wall tube. Impinging gases may lead to severe thinning at the entrance ends of the tubes which gradually diminish over a distance of about 12 to 18 inches. The 0.083" wall copper tubes originally used lasted less than two years. Replacement with Duplex — 0.055" copper over 0.035" aluminum greatly increased the life of the tubes in this service. After two years exposure, there was scarcely any corrosion detected.

More information on Duplex tube applications and methods of installation are found in Bridgeport's "Duplex Tubing Technical Bulletin No. 1950". Write for your copy on company stationery. (8753)

Instead of feeding makeup to the feedwater heater, he should run it to the hotwell using a float control valve to maintain a satisfactory level. Running the pump constantly while controlling level of water in the feedwater heater with a float valve in the pump discharge line will keep the heater working smoothly. Steam demand required to heat feedwater likewise will be constant. Adding makeup to the hotwell will tend to cool final temperature of the water.

Cuba, Ill. G. E. WINSHIP

Comments By Whitney

BEST SOLUTION to M.P.'s problem would be installation of a liquid level control on the hotwell and pump. This would maintain a more or less constant level in the hotwell. Higher suction head would be maintained, and entrance velocity to the pump would be reduced by throttling of the valve at lower hotwell levels. If it is desired to maintain as nearly steady flow from the hotwell as possible, an averaging level control should be used.

If makeup water for the boilers is available at 100 to 150 F, another solution would be injection of this water into the pump suction. Such cool water, to the extent of 10 to 20 per cent of pump discharge, would lower temperature 10 to 20 F. This is equivalent to increasing suction head 2 to 4 psig with water initially at 200 F. No heat is lost in this way, since cool makeup must be heated in any case.

Corpus Christi, Tex. L. A. WHITNEY

Two Solutions From Galloway

TWO INEXPENSIVE solutions are possible. First, extend sides of the hotwell upward as much as possible. Even a small increase will give extra volume. Install a float switch which will stop the pump at the point where vapor binding starts.

Second, install a Y fitting on the suction line near the pump. To the open branch connect a cold water supply (raw makeup). This injection should reduce temperature 10 degrees. A solenoid stop valve should be placed in the cold water line to prevent hotwell flooding.

A combination of these might be necessary, especially if raw makeup is a very small percentage of feed. Reduction in the speed of the pump would also help, but it is unlikely that any reduction possible would cure the trouble unless the suction pipe is too small in diameter.

Staten Island, N. Y. R. V. GALLOWAY

Numerous Improvements Possible

THERE ARE probably numerous ways to improve M.P.'s hotwell pump situation.

(1) If his pump is somewhat oversize, it should be possible to feed a portion of cooler makeup into the hotwell and perhaps obtain stable operation.

(2) If pump design was correct for operation close to the boiling point — suction eye basis — such as a normal condensate pump it should function acceptably as is.

(3) Heat exchangers have frequently been used in similar situations but it would require extreme design to avoid added loss in the pump suction connection.

(4) Hotwell level should be maintained at or above some definite value — for instance, permit free surge tank action above some fixed level but throttle pump discharge when level tends to recede. This can be done with a suitable float valve.

Most practical thing to do must be determined by local resources, heat balance limitations and perhaps by cost of the cure as compared to present risks.

Hazleton, Pa. C. W. BELL, SR.

Comments By Heyl

I WOULD suggest the following. . . . Install a float valve which will open slightly above the head at which suction breaks. A branch line of one quarter the capacity of the main pump outlet should be run from the pump outlet to the valve, and from the valve to the pump outlet.

At low head this will reduce the pump capacity 25 per cent, but will act as a primer for the pump.

Pittsburgh, Pa. R. M. HEYL

Freyberg's Suggestions

IF M.P. bought the pump especially for this job, it probably already has the largest suction eye on its impeller possible to prevent excessive cavitation. If not, maybe the pump manufacturer can provide an impeller which will operate effectively with NPSH available. Condensate of 200 F is not impossible to handle, but it requires special conditions which he evidently does not meet.

M.P. may be able to reduce suction pipe friction by increasing the size of the opening from the hotwell and of the pipe to the pump. Or he may be able to get along with a float control on the hotwell; in effect, keeping NPSH higher and probably lowering the temperature.

Another possibility is to introduce some makeup water into the tank. Somewhere in the cycle he is going to have to heat makeup water, and here he can mix it directly with high temperature water, and solve his pumping problem to boot.

Pleasantville, N. Y. R. H. FREYBERG

Provide Large Vent

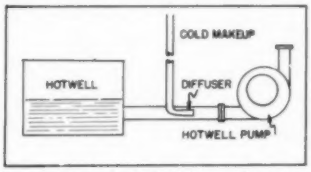
RUN A LINE between pump and hotwell as short and straight as possible. The line should be large enough to give about 1-fps velocity. At the pump's suction flange install a full line tee with side outlet pointed upward. Carry outlet of the tee vertically and full size to a point above the highest water level in the hotwell. Then, vent it with a small line without pockets. This should be done in addition to any pump casing vents. Most casing vents are not adequate to handle large amounts of vapor that form under M.P.'s conditions. This method will reduce flashing to a minimum with a good suction line and then, with a large vent as described, allow separation of the vapor that does form to be vented without entering and binding the pump.

Ithaca, N. Y. E. S. MONROE

Inject Cold Makeup, Says Moulton

UNABLE TO RAISE the hotwell or lower the pump, M.P. did not say whether the height of the tank could not be built up. A few added feet would increase positive suction head, provided, of course, the pump did not lower water level to the bottom. Perhaps, the pump could be controlled automatically or manually to retain a few feet of water in the hotwell.

A positive displacement pump, reciprocating or rotary, would help maintain suction, although water of 200 F should flow to the pump under several feet of head to avoid suction trouble.



Cold makeup water injected thru a diffuser into pump suction should cool pump, overcome trouble

If considerable makeup water is used, cold makeup, raw or treated, could be injected into suction by a diffuser to cool pump intake enough to overcome suction difficulties, as shown in the sketch. With this arrangement no changes would be necessary in either the hotwell pump or the hotwell, nor would there be any appreciable heat loss. Makeup water would be heated in any case so that heat loss to the condensate would be recovered by heating the makeup.

In this case it has been assumed that the hotwell pump is capable of handling all added water. This method of injecting cold or flash water into pump suction has long been used in vacuum return systems to kill vapor flash and hold the vacuum.

Pittsfield, Mass. A. H. MOULTON

Control Water Level, Says Justice

KEY TO THE problem lies in the sentence, "When the hotwell level goes down, the centrifugal pump begins to cavitate and steam bind . . ." It must be assumed from this that the pump operates satisfactorily when it starts. At this time water in the hotwell is at a high level. After the pump has run for a time, lower water level in the hotwell gives insufficient net positive suction head and steam bubbles form in impeller passages.

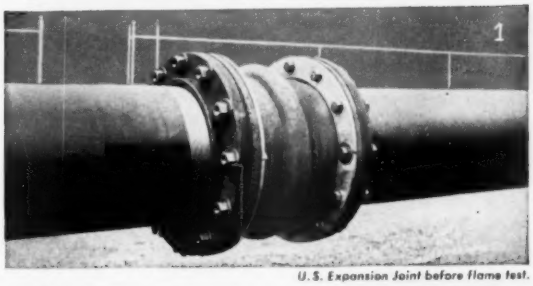
Solution, of course, is to maintain the level of hotwell water high enough to prevent steam binding. If the pump starts when water is near the top of the hotwell, and runs until water is near the bottom, it will merely be necessary to raise the cut-out point to

What's U. S. Rubber doing with expansion joints?

Making them flame-resistant, among other things. The U. S. Asbeston Expansion Joint originated by "U. S." is invaluable where fire is a hazard, and failure would shut down plant operations. Recommended for hot, dry gases (not steam) up to 300°F intermittently. The U. S. Asbeston, as well as the regular line of U. S. Rubber Expansion Joints, is used in pipe lines and mechanical equipment to absorb excess stresses due to expansion and contraction, to insulate against vibration, and to prevent the transmission of undesirable sound. These joints are also built to take care of misalignment, and are furnished either for pressure, or vacuum or both conditions: also specially made for fire safety on shipboard.

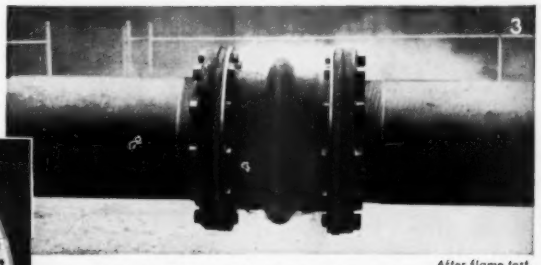
U. S. Rubber Expansion Joints eliminate many costly repairs, increase operating efficiency and extend the life of equipment. Because there are no moving parts to wear or bind, they give many years of service. Note in photos at right how an Asbeston test joint withstood a direct flame from fire built under it.

"U.S." has over 28 years' experience manufacturing expansion joints. Write to address below.



U. S. Expansion Joint before flame test.

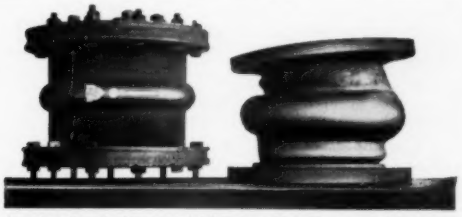
During flame test.



After flame test.

U. S. Asbeston® Expansion Joints are flame-resistant. They have been approved by government and industry.

One of two U. S. Rubber Expansion Joints used in condenser turbines of a power development plant in Oklahoma. The triple arch joint shown has inner diameter of 72" and the joints will compress 2½" to 3" and expand 1¼" to 1½".



In a test for shock, a metal joint and a U. S. Expansion Joint were filled with water and 463 lb. weight was dropped on each from a height of 10 feet. The metal joint (at right) collapsed at the first shock, while the U. S. Joint remained unaffected even after the test was stopped at 15 feet.

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a higher level. Even if the cut-out is located 6 in. below the cut-in point, no additional power will be used. Instead, the pump will start more frequently and pump less water each cycle. To be certain the level never goes too low, it is recommended that the cut-out be actuated by a positive control, such as a low-water cut-off or an electrode type. Figure 1 illustrates a hotwell operated in this manner.

This type of control will give satisfactory performance only if a hot-process softener is used for makeup. In this way, there is little temperature variation of feedwater entering the deaerator, so proper deaeration is obtained at all times with maximum utilization of exhaust steam.

If M.P.'s softener is of the sodium zeolite type with cold water effluent, start-and-stop control with 200 F feedwater will probably result in poor deaeration and inefficient use of exhaust steam. When the hotwell pump

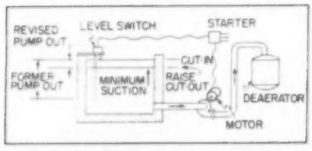


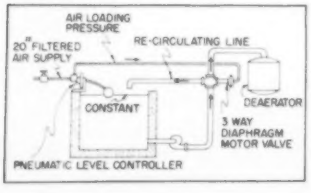
Fig. 1. Start-and-stop control to maintain hotwell water level requires raising of the cut-out point

is sending 200 F condensate to the deaerator, little exhaust steam is required to heat feedwater. Then, when the pump stops, cold makeup water must be added in large quantity. This immediately causes exhaust steam pressure in the deaerator to drop to zero, adversely affecting deaeration and calling for live-steam makeup.

More efficient operation of the steam plant will result if the condensate pump can be run continuously, pumping condensate to the deaerator at all times. A throttling or recirculation valve on pump discharge will be needed so that condensate is pumped out just as fast as it enters the hotwell. With a relatively constant flow to the deaerator, the amount of cold makeup will be reasonably steady. Exhaust steam pressure in the deaerator will hold constant, little or no exhaust steam will be wasted, and live-steam makeup will be at a minimum. Deaeration will be at its maximum.

With 200 F condensate, throttling control of pump discharge should not be used because heat generated by

Fig. 2. Recirculation system with a float-operated level control will hold water level within 4 in.



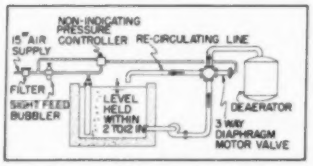


Fig. 3. The air-bubbler type of pneumatic control is least expensive recirculation system discussed

the impeller at low loads would cause vapor binding of the pump. This is the condition M.P. now has, and wishes to avoid.

A recirculating type system is recommended, with a pneumatic level controller capable of holding hotwell level to close limits. One three-way diaphragm motor-valve or two regular diaphragm motor valves, one direct acting and one reverse acting, should be used. A pneumatic recirculating system using a float-operated level controller is shown in Fig. 2.

An air bubbler system of pneumatic control for recirculation can also be used, as shown in Fig. 3. Cost for an air-bubbler system should be slightly less than for a float-operated one.

Operating cost for the pump will be higher for a recirculation system than for a start-and-stop control. In most cases, however, more uniform operation of the entire plant, better deaeration, and more efficient exhaust steam utiiization will more than compensate for the slightly increased pumping cost.

One note of caution — because the hotwell pump will be operating very close to cavitation conditions, condition of the impeller should be carefully checked at frequent intervals. Exact curvature of impeller inlet vanes is extremely critical, and is virtually impossible to check in the field. A slight change in their curvature will cause capacity of the pump to fall off rapidly, and steam binding will result. A spare impeller should be obtained and installed every few months while the other one is sent back to the pump manufacturer for checking and reconditioning, or replacement. M.P. can try different periods of time until he can determine life-span of the impellers.

Silver Spring, Md. W. C. JUSTICE

Comments by Rule

ONLY PRACTICAL things that might help M.P. are considered too expensive or prohibitive. Therefore, only other method not too costly would be to find the level in his tank where cavitation takes place and maintain that level with temperature not exceeding tested temperature for this level.

I would suggest M.P. buy a float valve and connect this to his cold makeup. Controlled for the correct level he must maintain for operation, the valve should be very responsive. He should then connect his makeup discharge in the immediate area around the pump suction, so that at the time the pump is near its critical operating point the head will be held, and water temperature will be lowered when it is most needed. A little experimenting with this set-up may produce a slightly lower level in the sump tank, and prevent cavitation. Makeup being added at this point also may prevent the pump from being damaged from lack of returns at any time.

Princeton, N. J. M. E. RULE

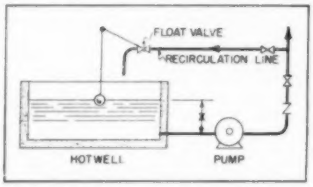
Lower Condensate Temperature

IN ORDER to prevent cavitation and vapor binding of the centrifugal pump handling 200 F returns, install a float-operated makeup line of cooler water opening at the low level and decrease the temperature of the condensate. There would be no heat loss, which M.P. is apparently concerned about.

Iroquois, N. Y. C. F. BISHOP

Recirculation Successful in Similar Situation

IT WOULD BE a simple problem, if the pump's characteristics and net positive suction head were known.



Float valve in sketch opens to maintain submergence "x", which should be as great as possible

We have used a recirculating line with success to keep the condensate from dropping to a low level and run the pump continuously, as shown in the sketch.

Chicago, Ill. M. EVANS

Several Simple Changes

QUESTION NO. 497 in the August issue, concerning M.P's. hotwell pump, suggests several simple changes that should be helpful.

He does not state what the depth of water is in the hotwell when the pump apparently functions without trouble, but if this level could be maintained, I believe a large part of the difficulty would be overcome.

A simple way to accomplish this is to install a float-operated balanced valve in the discharge line between the pump and deaerating heater.

Float rides on the surface of the water and opens the valve more or less according to the amount of condensate flowing into the hotwell, thus holding water level and pump submergence practically constant.

A small by-pass with a globe or gate valve should be fitted between the pump and the float valve, and carried back to the hotwell so there will always be some water circulating through the pump to prevent damage to internal parts, when float valve is closed or nearly so.

Another very desirable change, if the layout permits, is to increase the size of suction pipe to the pump to minimize friction loss and pressure

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drop when pump is delivering at or near its rated capacity. Attention should also be given to smoothness of the entrance to suction pipe in the hotwell to reduce turbulence at this point.

Condensate of 200 F or more is successfully handled by centrifugal pumps in many plants with very moderate suction head on the pumps.

As a last resort a small cold water connection can be fitted to the suction line near the pump and be used to slightly cool condensate to a temperature where it will not flash. This is frequently done with reciprocating pumps on the return end of vacuum heating systems and is quite effective.

No heat will be lost in the process as it is returned together with the cooling water to the deaerator for further heating to boiler feed temperature.

Warwick, R. I. A. M. LEADER

Recirculate, Says Hider

SINCE IT was stated to be impractical to relocate any equipment, I would suggest recirculation of a portion of the pump discharge to the hotwell.

Because complete information regarding piping and controls associated with the deaerator were not given, certain assumptions must be made. Specifically, these are:

(1) That the deaerator is equipped with a means of introducing makeup automatically as required. This is shown on the diagram as a float-operated control valve, which would be arranged to open if the supply from the hotwell pump could not meet the demand. If such a connection does not exist, it should be added.

(2) That the deaerator is equipped with a means of regulating output of the hotwell pump.

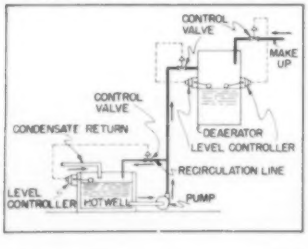
As shown in the diagram, two level controllers are used to control two separate valves; one to regulate flow of the hotwell centrifugal pump and the other to control makeup. Two controllers would have to be arranged physically so that in the event the hotwell pump control valve opened fully, and there was still a demand for more water (i.e. deaerator level continued to drop), the makeup control valve would open to supply water required.

Of course, if air-operated control valves are used, one float-operated air pilot would be sufficient to operate the valves. In this case, the pump control valve would operate over a range of, say, 3 to 10 lb air pressure, and the makeup control valve would operate over a range of 8 to 15 lb.

The problem is that the pump does not have sufficient net positive suction head to handle 200 F water when the hotwell level decreases. I believe the solution would be to install a recirculation line from the pump discharge to the hotwell. A level controller should be installed in the hotwell which would operate a control valve in this line. Size of the line and valve would be determined by capacity of the pump, total head relationship between deaerator and hotwell, and maximum amount of water which must be recirculated to maintain hotwell level. This last quantity would have to be determined by tests.

Binghamton, N. Y. A. W. HIDER

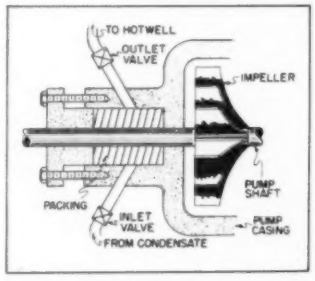
Diagram by Hider showing recirculation system with float-operated level controllers and control valves



Riley Suggests Water Seals

M.P. HAS a very simple problem — he only needs to do two things:

(1) Install or rework his centrifugal pump to provide water seals at the pump packing glands. If he can use condensate for this, so much the better. If not, raw water is satisfactory. However, I prefer condensate. I would suggest taking the condensate from the turbine condenser hotwell pump line. Sketch shows hook-up for water seal packing gland.



One of two things Riley suggests to solve M.P.'s problem is to fit the hotwell pump with water seals

(2) Install a float-type switch in the hotwell tank for positive head on the suction side of the pump.

I believe this will solve his troubles.

Brunswick, Ga. B. D. RILEY

Use Float Valve, Says Morley

A VERY SIMPLE and effective solution of M.P.'s problem is to maintain hotwell level above the level where difficulty arises.

To do this he would only have to install a quick-opening lever-operated valve on the discharge line above his pump, and level with the top of the tank. He can hinge to the top of his tank an L-shaped bar — with the float attached to the long leg of the L. The short leg should have three or four holes bored in it to adjust the float. A bar or light rod should connect the lever on the quick-opening valve to one of the holes so that when water level in the hotwell falls, action of the float closes the valve slightly thus shutting off slightly discharge from the pump.

The float can operate the valve from wide open to closed and will maintain a constant water level in the hotwell. I am sure of this, for I am using such a device on an installation practically identical to the one M.P. describes.

Chula Vista, Calif. H. P. MORLEY

Build Up Hotwell

M. P. STATES that he has good reasons for not being able to lower his pump and suction line from concrete tank. He did not say whether he has head room for increasing side walls or height. If he has head room, or can make head room without too much expense, the tank height can be increased, a float control cold water makeup valve installed and a higher constant level head on the pump can be maintained.

This additional depth would provide space in event of receiving more returns back than steam output which sometimes occurs on start-ups, shutdowns and changes in load. Of course, this would give practically the same results as lowering the pump — more head.

Another thing that could be done is to install a coil in the bottom of tank through which cold water is preheated on the way to plant hot water generators or processes. Other possible causes might be: suction line too small; steam strainer or perforations too small, or strainer area of insufficient size.

Dallas, Texas MATT JONES

Answer No. 498

Will His Pump Lose Suction After Shutdown?

THE PUMP *will* lose suction when stopped. Pressure acting downward inside the pipe is 10 ft (of water) and pressure exerted by water in the bay is only 8 ft, tending to hold water in the pipe. Since the head is greater inside the pipe, water will run out of the pipe until the two pressures are equal. This will be at a point where the water is exactly 8 ft up from the bottom of the pipe. These figures are all based on the high tide mark, and it is assumed that the bay holds a large quantity of water compared to the 3180 gal in the suction line.

We have a similar suction piping arrangement on our 1500 gpm centrifugal river pump. Main difference is that the suction line has no vertical riser at its end, but slopes gradually to the river to a point about 10 ft below mean low water. Its length is approximately 500 ft. We lose suction each time the pump is shut down and must pull water up to the pump with a vacuum pump connected with its suction at the top of the centrifugal pump casing. This operation takes approximately 10 minutes.

Media, Pa. ROBERT K. BROWN

R-S valvEvents

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Low Pressure Drop Saves Power. In the open position the streamlined vane causes a Venturi action. Pressure drop is therefore exceptionally low. Pumping costs are reduced accordingly.

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Maintenance Practically Nil. Every R-S Valve is designed and constructed for rugged service and provided with safety factors to give complete satisfaction in the service for which it is designed. Packing trouble is not common to R-S Valves since the shaft moves only with an oscillating motion.

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Inside-Out Insulation for Bananas

By C. T. BAKER
Consulting Engineer

In cold storage work, bananas are tricky because of their high water content. This produces a difficult insulation problem. But the author solved it by turning the construction of the building inside out

DON'T PUT bananas in the refrig-er-ator" — at home. But in commercial storage, they first heat 'em, then cool 'em, both at high humidity. And since insulation would soak up lots of water from bananas and conditioning air, curing rooms can be insulated inside out. Here's how it's done.

About two years ago, I laid out a new cold storage plant which included three banana rooms. Figure 1 shows a portion of the general plans of the development, which was being built to replace a structure that had served a growing business for 25 years.

At the outset, the owner made it clear that he would not consider the use of insulation on the floor or walls of his new banana rooms regardless of any claims about water absorption. I found that he had ample evidence to support his position. Water that had been sprayed into existing rooms at certain intervals to raise humidity had ultimately found its way into insulation on the walls and floor. Its water-soaked condition left it little value as a retarder of heat flow.

Ripening Bananas

Ripening, curing and storage of bananas, if properly done, requires both heating and cooling of room air. This must be performed under accurately controlled conditions of temperature and humidity. The fruit is damaged easily by temperatures that are too low and, because of this, must be handled carefully from the time the bunches are cut from the trees until they are properly ripened and ready for market.

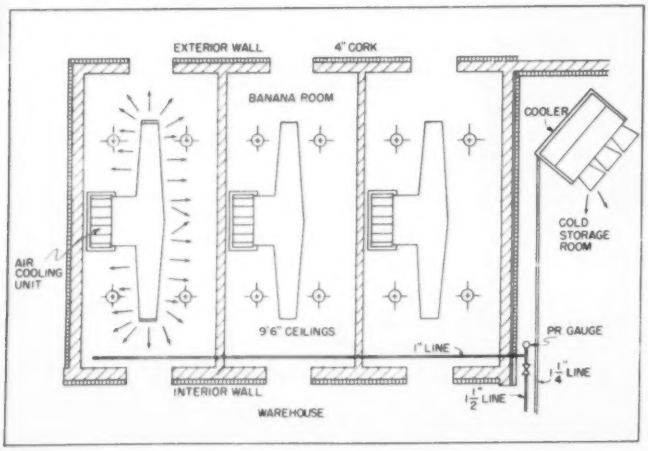
Bananas average about 75 per cent water to about 25 per cent solid matter — a very perishable product. Normal ripening time is four days. During the first 16 to 18 hr a uniform temperature of 70 F and a relative humidity of 90 to 95 per cent must be maintained. It is also important that air circulation be good during this time.

Following the first stage of the ripening period both temperature and humidity are lowered as quickly as possible, and for best results, should be maintained at 64 F and 89 per cent relative humidity during the rest of the ripening.

Humidity is controlled by spray nozzles installed on $\frac{1}{2}$-in. diam water supply lines located in the center of each room. Nozzles are placed just below air outlets from the ducts.

From this description of temperature and humidity requirements, it is evident that it would be next to impossible to prevent absorption of water by any type of insulation installed within the rooms.

Fig. 1. Portion of plans shows three banana rooms and part of large cold storage room. Four-inch cork insulation was applied to outside of banana room walls because of the high humidity required for curing



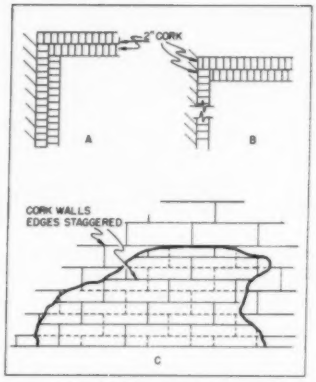


Fig. 2. Wall and ceiling insulation joints are shown for banana rooms (A) and cold storage room (B). Two 2-in. cork layers were staggered as in (C)

Outside Insulation

Lowest temperature to be maintained in the new banana rooms was 55 F. Since the ground beneath the rooms was a loose fill, heat calculations showed that floor insulation would not be economically justified in this instance.

Exterior walls were protected against weather damage by a canopy which extends over the loading platform on the exposed end of the building. It was decided to place 4-in. of sheet cork insulation on the outside surfaces of three partition walls inside the building. First the walls were back plastered with Portland cement mortar to provide a suitable surface to receive insulation, and then were given two coats of asphalt priming paint. Sheet cork was then erected in place and given a Portland cement mortar finish.

Insulation was further protected by corrugated aluminum sheets extending from the floor line to within about 4 ft from the top of the walls. This prevents damage from trucks and other sources.

Ceiling insulation was placed on top of the ceiling and a built-up roofing laid directly upon it. Wall and ceiling insulations were fitted together in such a way as to make a tight joint. This construction is shown at A in elevation over the banana rooms and at B in elevation over the cold storage rooms in Fig. 2. Details of the application of the cork board insulation to the walls, showing how both the longitudinal and vertical joints were broken, is at C in the drawing.

The new banana rooms have been in operation since 1950 and have proved satisfactory in every way. Incidentally, heating during the curing period is provided by hot water circulated through a separate coil located in floor type air cooling units that are used for holding the room temperature at 55 F following curing.

Are You Making Pure Steam?

Here are two practical boiler room tests to help you find out. One is a conductivity test alarm system, the other a test for steam corrosivity

STEAM PURITY is usually associated with the solids content of steam — steam corrosivity is often overlooked. Since the objective of steam production is to produce the highest quality product possible, investigations of purity must of necessity consider corrosive characteristics of steam as well as solids content.

Corrosive characteristics are imparted to steam by the presence of corrosive gases, usually carbon dioxide and oxygen. Damage that may be caused by the influence of these two gases is appreciable. The corrosion of equipment, both steam and return line, from these causes can be determined and prevented.

Solids Content

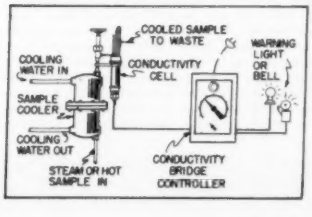
Maintaining a check on the low solids content of steam is, of course, a well recognized part of any boiler feedwater conditioning program. Representative samples of steam may be checked for solids content with a simple conductivity bridge. Figure 1 illustrates a simple system which will provide an alarm when conductivity exceeds a predetermined figure, according to *The Betz Indicator*.

Detailed investigation of the effect of variables on the solids content requires more elaborate testing equipment. In such studies it is usual to use a Straub Degassing Condenser in conjunction with a conductivity recorder.

Use of the degassing condenser is also necessary where the carbon dioxide and/or ammonia content of steam is relatively high. Ammonia, in particular, possesses high conductivity. Without degassing, it would be very difficult to interpret the conductivity record, particularly since ammonia in the system will vary with load swings.

Recording equipment of this nature is of considerable value in determining the ability of anti-foam agents to relieve a carryover condition or to permit maintenance of elevated boiler water concentrations without carryover. The use of such agents in raising permissible boiler water solids is readily demonstrated by the results of a study, using this type of equipment, summarized in Fig. 2.

Fig. 1. Alarm system for continuous check on solids carryover employs a simple conductivity bridge



Both the conductivity bridge and the degassing condenser were thoroughly discussed in the December 1948 issue; in The Conductivity Test — Important To Boiler Water Control.

Steam Corrosivity

Carbon dioxide is the principal cause of steam and return line corrosion. It is present in steam from the boiler because of the breakdown of bicarbonate and carbonate alkalinity in the boiler, a source which is not affected by mechanical deaeration.

Oxygen, on the other hand, is usually eliminated from the steam by a deaerating feedwater heater and the use of sodium sulfite as internal treatment. It can, and does, enter into the problem of return line corrosion where vacuum pumps are used and air is drawn into the return system, or where oxygen-laden water is introduced at some point in the system.

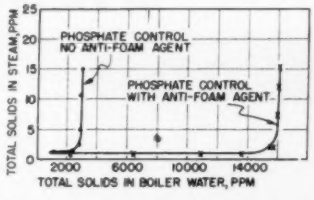


Fig. 2. Purity tests show value of anti-foam agents in raising permissable boiler water solids

Chemical tests will indicate the quantity of corrosive gases in steam, but corrosion of equipment is not always directly related to these concentrations. It is possible, depending upon steam-condensing equipment, to develop high local concentrations of carbon dioxide; but resultant corrosion in any particular section of the system is not necessarily in direct proportion to gas concentration of steam leaving the boilers.

More accurate determinations can be made, therefore, by sampling corrosivity of the condensate rather than attempting to predict it from the amount of carbon dioxide in the steam. Direct measurement of condensate corrosivity can be made from test specimens, exposed either in a condensate line or in a by-pass arrangement.

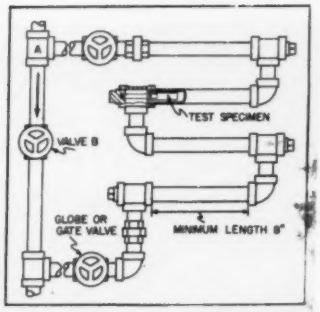


Fig. 3. Arrangement of typical test specimen by-pass installation showing placement of specimens

A test specimen by-pass, typically like that shown in Fig. 3, should be installed at those points where it is known that corrosion is apt to take place. Installation of specimens at appropriate points in the return line should also be used to measure oxygen contamination.

How The Tests Work

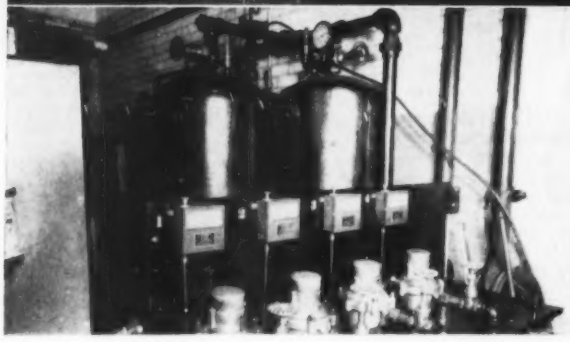
Prior to exposure, specimens should be carefully cleaned and weighed. After exposure, they should be cleaned and weighed again. Average penetration in inches per year is calculated from weight loss and time of exposure.

Specimens should be placed at points where they will be continuously submerged, and at a point of good condensate flow. Four specimens are usually installed in the by-pass at one time, and usually two are withdrawn after a specified time to provide a check against possible error.

Following specimen exposure procedure before and after application of a corrective treatment offers an accurate way of determining treatment effectiveness. Later, if test locations provide consistent results and corrective treatment reduces corrosivity of the condensate, specimens may be withdrawn one at a time over a period of months to figure the rate of decrease of corrosion.

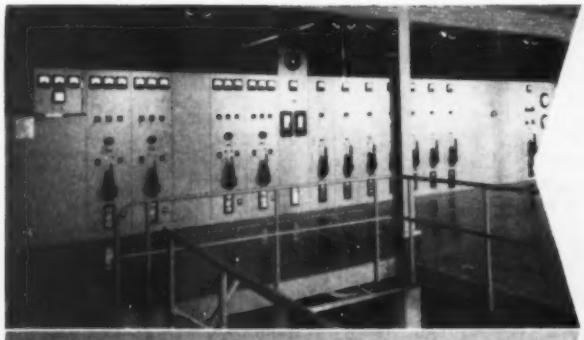
Flat test specimens, like those shown in Fig. 3, are usually used in order that film formation can be detected. One of the methods of reducing steam corrosivity is by the use of filming amines. How Filming Amines Prevent Steam and Return Line Corrosion, in the June 1950 issue, covered the use and merits of this method. Generally, they are designed to provide an impervious, non-wettable surface to equipment, thus resisting carbon dioxide and oxygen attack. Another form of amine, frequently used, controls the pH of the water to minimize corrosion.

Two identical batteries of five DeLaval centrifugal pumps, one set driven by five Superior diesel engines totaling 1690 hp and the other by five Crocker-Wheeler electric motors, are capable of throwing 34,000 gal of water per min as fire protection equipment at New York's Idlewild Airport. The diesels are equipped with every protective device and operating accessory required in plants designed for continuous duty. City water mains plus four reservoirs with a capacity of 1,000,000 gallons supply water

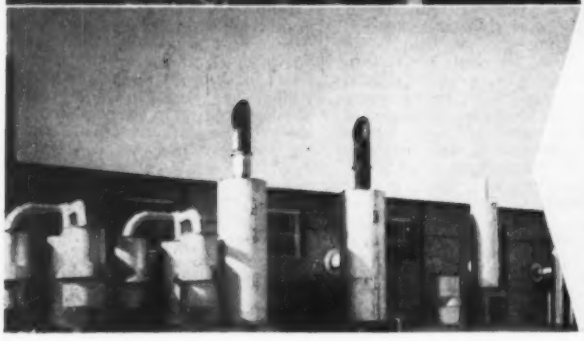


Fuel oil for each of Glencoe, Minnesota, municipal power plant's 4 diesel engines, with a total capacity of 4300 hp, is measured with a Hersey meter, and each day tank has a Liquidometer levelmeter. Glencoe, in an area where natural gas is not available, recently switched from a gas oil to crude oil in an effort to combat the high price of fuel oil. First year's operation on crude oil cut the fuel bill more than $8,000. The diesels were also reported to run cleaner and with higher efficiency

DIESELS in the



This completely modern switchboard serves a new municipal power plant at Beloit, Kansas. Designed by the station superintendent, many of the parts of the new board were salvaged from an old one. Primary circuits are separate, and there is nothing over 110 v on either side of the main board. Beloit has two 2100-hp Fairbanks-Morse dual-fuel engines and two 1080-hp Alco diesels, generating 4500 kw. One diesel is being converted to dual-fuel-operation; the other one for stand-by duty

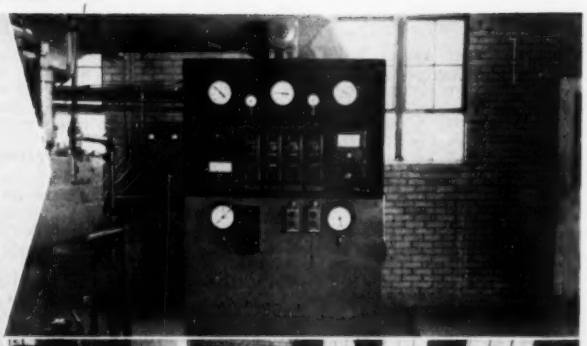


Scavenging air for each of the two-cycle dual-fuel engines in Beloit's spacious new plant is drawn through these American Cycloil two-unit oil-bath filters and Maxim intake silencers to the engine's built-in scavenging blower. Exhaust gases pass through vertical Maxim silencers outside the plant. All exhaust lines in the plant are insulated. Starting air is provided by a 15 cu ft Ingersoll-Rand compressor driven by an automatically-controlled motor which keeps pressure between 200 and 250 lb

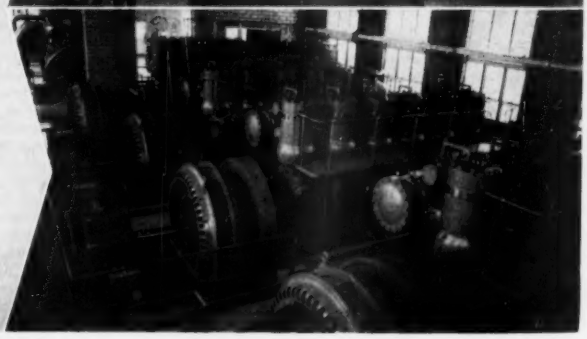
Integral pieces of Glencoe municipal power plant's lube and oil filtering equipment are, from left to right: a Honan-Crane fuel-oil purifier; a 10-element Fairbanks-Morse cellulose pressure-lube system through which detergent-type lubricating oil is by-passed continuously from an opposed-piston diesel lube unit; and three Honan-Crane fuller's earth lube purifiers for the other diesels. Also included in the lubrication system are a shell-and-tube oil cooler, and a motor-driven auxiliary pump

At the David City, Nebraska, municipal power plant, exhaust gases from the plant's 1440-hp Worthington dual-fuel engine pass through this Foster Wheeler waste heat boiler. The unit keeps feedwater hot and permits a relatively quick start for the 625-kw Allis Chalmers steam turbine, which was the principal prime mover until installation of the engine. Today, the dual-fuel diesel engine carries 96 per cent of the city's total electricity requirement, at a saving in fuel costs of more than 50 per cent

NEWS REEL



This compact control panel for the 2000-hp dual-fuel Fairbanks-Morse engine in the municipal generating station at Weatherford, Texas, is located right at the side of the big engine. Starting and operation of the engine is controlled from the panel, which includes an Alnor pyrometer, a day tank level meter, pressure gages, and alarms and push-button controls for auxiliary equipment. The engine, converted to dual-fuel in 1951, is completely independent with its own cooling and lubricating system



From right to left are three 450-hp diesels installed in 1941, a 1200-hp diesel and, in a new section of the plant, the 2000-hp dual-fuel engine, in the municipal plant at Weatherford. Cooling water for the dual-fuel engine is passed through an evaporative cooler. Other engines in the plant make use of a closed system with heat exchangers. Weatherford is about 30 miles from Fort Worth, in the heart of the watermelon and natural gas country, and first began operation of its own plant in 1947

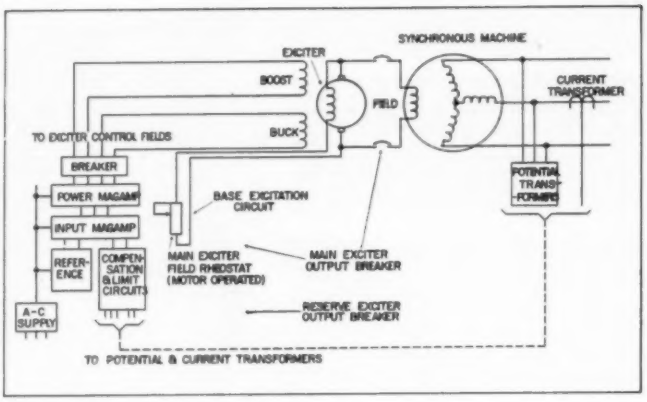


Fig. 1. Simplified schematic diagram of new regulation system for synchronous machines. Magamps amplify output of regulator circuit before it is fed into main exciter's control fields to raise or lower machine voltage. Entire regulating system is assembled in standard switchgear cubicles, and is factory adjusted and tested

By

J. E. BARKLE, Electric Utility Engineering
C. E. VALENTINE, Switchgear Engineering
J. T. CARLETON, Industry Engineering
Westinghouse Electric Corp.

High-Speed Regulating

HEART OF a new high-speed regulating system for excitation of synchronous machines is the magnetic amplifier. The magnetic amplifier (Magamp) has a shorter time delay than a rotating amplifier, and when used in connection with a self-excited exciter, provides a regulating system that has a faster response. A static device, the Magamp, replaces the rotating amplifier and eliminates its brushes and commutator, with their attendant maintenance problems. Result — a system that is fast, reliable, and requires little or no maintenance. Basic elements of the system are the same for any type of synchronous machine, so the Magamp regulator can be used with turbine generators, waterwheel generators, or synchronous condensers.

About 50 years ago, a regulator with continuously vibrating contacts was used for automatic control of excitation. Then the rheostatic type of excitation system was developed; this system, more than 20 years old, is still being applied. Some 10 years ago the rotating amplifier was developed into the Rototrol system, using an impedance-type regulator. Another system, using an electronic main exciter, has also given excellent results.

The Magamp system is an outgrowth of a comprehensive examination of the advantages and shortcomings of these systems. The result of these studies is the regulating system illustrated in Fig. 1.

The synchronous machine has a self-excited main exciter; manual control of excitation is accomplished by adjusting the motor-operated field rheostat. This provides a manual control that is simple and easily understood by the operator.

How System Works

The main exciter has two separately-excited control fields energized by the power Magamp. Under regulator control, the motor-operated main exciter field rheostat is set manually to produce a base excitation for the machine. The power Magamp puts energy into either the boost or buck control field to raise or lower the excitation voltage to the value required to maintain a fixed machine terminal voltage.

The combination in the main exciter of a self-excited field and separately-excited control fields provides simple and effective control of the exciter voltage. There is a definite advantage over separately-excited main exciters, because loss of the separate excitation does not seriously disturb the main unit under normal operating conditions. Operation continues with the excitation provided by the self-excited field, as under manual control. Use of separate fields to provide the buck-boost energy eliminates switching in the self-excited field circuit when changing from manual to automatic voltage control.

Components of System

The four static components of the Magamp regulating system are shown in Fig. 1. The reference component, energized from a separate a-c supply, develops the reference quantity used as a basis for comparison. At a-c supply frequencies of 70 and 140 per cent of normal, the reference error is less than 2 per cent. Variations within the usual operating range of plus or minus 0.5 per cent of the base frequency cause less than ± 0.1 per cent error. Thus, the reference is ideal for waterwheel generators, which are subject to raised frequency and voltage following load rejection and during runaway conditions. The increase in synchronous-machine terminal voltage above the reference causes the regulating system to force down the excitation voltage and attempt to maintain approximately the predetermined voltage level even though over-speed has increased the frequency.

The compensation and limit circuits are energized from the synchronous-machine terminal voltage through potential transformers, and from phase current through a current transformer. The compensation circuits provide reactive-droop compensation as required by the system and line-drop compensation. Reactive-droop compensation causes the proper distribution of reactive kilovars among machines that operate directly in parallel. Line-drop compensation causes the regulating system to maintain constant voltage at some point on the system remote from the machine being regulated.

An underexcitation limit is normally provided in the limit circuits for all synchronous machines. It prevents the regulator from reducing the exciter voltage, and consequently the excitation, to a point that would jeopardize the stability of the machine with the system. The lower limit of excitation can be adjusted as kilowatt and reactive load changes. In any case, the lower limit is a variable that depends on the machine loading. An overexcitation limit can also be provided for synchronous condenser applications where the maximum continuous load must be limited.

How Error Signal Is Used

The synchronous-machine terminal voltage, as modified by the compensation and limit circuits, is supplied to the input Magamp where it is compared with the reference quantity. Any deviation of the terminal voltage from its normal regulated

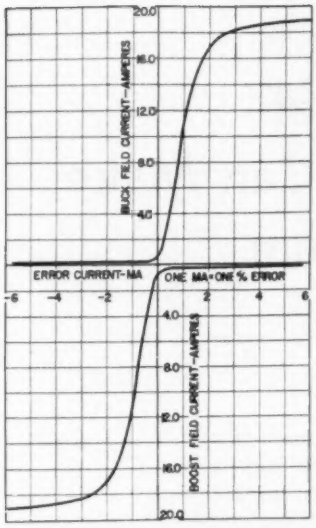


Fig. 2. Error signal input versus power Magamp current output for boost and buck error signal

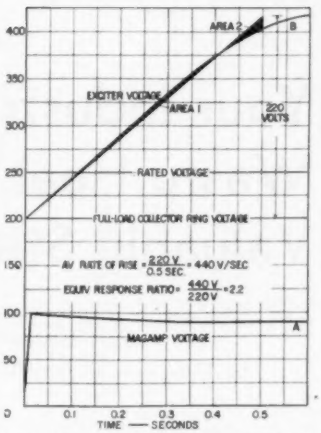

AREA 2
EXCITER VOLTAGE
AREA 1
220 VOLTS
RATED VOLTAGE
FULL-LOAD COLLECTOR RING VOLTAGE
AV RATE OF RISE = 220 V / 0.5 SEC = 440 V/SEC
EQUIV RESPONSE RATIO = 440 V / 220 V = 2.2
MAGAMP VOLTAGE
TIME — SECONDS

Fig. 3. Rate of response of Magamps and of main exciter. In determining equivalent response ratio, a straight line is drawn from origin of exciter voltage curve so that Area 1 equals Area 2. Average rate of rise from full-load collector ring voltage is 220v divided by 0.5 sec, or 440v per sec. This figure, divided by 200 (full load collector ring voltage, as shown in the diagram) gives an equivalent response ratio of 2.2

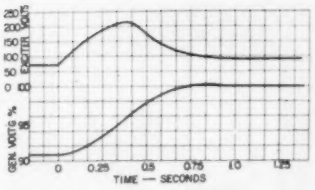


Fig. 4. Response of regulating system to sudden change in reference setting of the exciter voltage

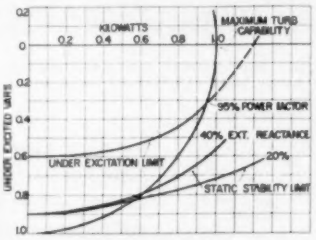


Fig. 5. Typical setting for underexcitation limit coordinated with capability curve of the turbine

System for Generator Excitation

value causes a difference between the reference quantity and the voltage output of the compensation and limit circuits, which becomes an error signal. The error signal is amplified in the input Magamp and supplied to the power Magamp. The power Magamp includes two magnetic amplifiers; one biased to respond to a boost error signal and energize the boost control field, and the other biased to respond to a buck signal and energize the buck field.

The a-c supply for the reference unit and magnetic-amplifier circuits is important. To provide maximum reliability of the regulating system, the a-c supply is obtained from a permanent-magnet generator driven by an induction motor. Having no commutator, sliprings, or brushes, the permanent-magnet generator set is a rugged and reliable device that requires no regular inspection or maintenance. A flywheel provides sufficient inertia to carry the set through voltage disturbances on the a-c circuit that supplies the motor. The m-g set can be energized from the synchronous-machine terminals, the powerhouse auxiliary system, or any other acceptable source of power.

One design of reference unit, input Magamp, and compensation and limit circuits is used for all types and sizes of a-c machines. The ratings of the power Magamp and permanent-magnet m-g set are determined by the main exciter size and speed.

In a magnetic amplifier, a higher supply frequency results in faster response and smaller magnetic-amplifier reactors. Therefore, having chosen an m-g set as the most reliable a-c supply, the frequency of the permanent-magnet generator was established at 420 cycles nominally. The result is a regulating system with very fast response and relatively small size. This higher frequency also simplifies stabilization of the regulating system because of the short time delays.

Generator Test Performance

Components of the Magamp regulating system are assembled in a standard low-voltage metal-enclosed switchgear cubicle adjacent to the exciter field rheostat and field breaker cubicles. The entire assembly is completely factory adjusted and tested, and is shipped to the user ready for installation.

To obtain response and performance data, the 420-cycle Magamp system was tested in conjunction with a 65,000-kw, 81,250-kva, 0.8 power factor, 3600-rpm turbine generator excited by a direct-connected 215-kw exciter. The results show the Magamp system to be faster in response — for either small or large deviations in voltage — than any known excitation system employing a rotating-amplifier pilot exciter. This is essentially due to the shorter time delay of the magnetic amplifier.

Amplification obtained with the input and power Magamps in these tests is shown in Fig. 2. The power Magamp is driven to its ceiling output with an error signal of 2 ma (milliamperes). Deviation in generator voltage required to produce this error signal is approximately 2 per cent, so that maximum forcing is obtained for small deviations.

The extremely fast response of the Magamps is illustrated by curve A, Fig. 3, which shows that the power Magamp reaches ceiling voltage in approximately 0.02 sec, or 1.2 cycles on a 60-cycle basis. The output voltage of the main exciter, curve B, Fig. 3, reaches its maximum magnitude of 420 v, or 168 per cent of rated exciter volts, in approximately 0.6 sec. If the equal-area criterion of determining exciter response ratio is applied to this curve, that is, making area 1 equal area 2, the equivalent response ratio of the excitation system is 2.2.

Recovery Rate Test

A series of tests was made in which the magnitude of the regulated voltage was suddenly changed a predetermined amount and the recovery rate of the a-c generator voltage recorded. A typical example is given in Fig. 4, which shows the main exciter increasing from 72 v to a maximum of 212 v in 0.38 sec, while the generator voltage changes 9.2 per

(*Continued on page 132*)

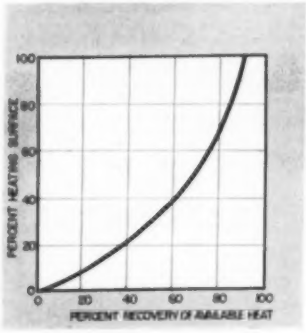


Fig. 1. Relation between boiler surface and heat recovery based on E=0.9 for 100% surface

Your Industrial Waste Heat Can Make Valuable Steam

By **ROBERT CUBBERLY** and **KELVIN J. RAY**

Process Engineers, Industrial Division, Foster Wheeler Corporation

Here are general principles in selection and arrangement of waste heat boilers for industrial heat recovery and process temperature control, with examples. Emphasis is on factors that influence economical selection and give a design free of costly operating troubles.

THE POWER ENGINEER must constantly devise ways of utilizing the excess energy that must be discharged from industrial processes. The waste heat boiler is often the instrument best suited to recover some of this excess energy. Often it will serve a dual purpose; first as a means of process control; second, as a means of energy conservation. It may be used to control temperature of an exothermic reaction to maintain a favorable reaction equilibrium. It may serve as a condenser to remove heat of vaporization; and it may be used for rapid cooling of a gas, liquid or a fluidized solid.

This discussion is limited to the steam boiler including the steam superheater and feedwater economizer. Liquids having thermodynamic properties differing from water may be used, in which case the same general principles will apply.

Heat Recovery

First consideration is quantity of heat available. Only that heat contained in the hot fluid which is measured above the lower temperature of the cold fluid is transferable, if a counter flow arrangement is used.

The authors explained the equations for heat flow and efficiency in a paper on The Design and Application of Waste Heat Boilers before the annual ASME meeting in 1951. They also included equations of thermal efficiency in terms of rate of heat transfer, surface area and flows.

Where heat economy is the only purpose of the waste heat boiler, the value of E selected will, of course, not exceed that which provides all the steam that can be used. Some installations for process temperature control have proved economical even though the steam could not be used, but in general the value of steam will determine the E factor.

In some instances of process temperature control, it is advantageous to use a steaming economizer in connection with a boiler. In such cases, the steaming portion of the economizer is treated as boiler surface.

Types of Boilers

The two basic boiler types are fire tube and water tube. Characteristics of the hot fluid that bear on selection of the type boiler include: 1. Physical state — gas, vapor, liquid, fluidized solid, pressure, temperature and density; 2. Properties — viscosity, thermal conductivity and specific heat; 3. Activity — reaction to boiler materials; 4. Contaminants — degree of surface contamination expected as affecting heat transfer and pressure loss.

Steam and water conditions will affect the choice of type principally with respect to pressure, means for separating the steam from the water, means for keeping hot surfaces wet and means for cleaning the water side.

Special tube shapes and extended surface arrangements are applicable to both types of boilers. Extended surface is applied only to the hot fluid side, where the film rate of heat transfer is considerably lower than the boiling-water film rate. It serves in such instances to make more efficient use of the water-side surface, resulting in a more compact arrangement. Water circulation rate, fluid temperatures and heat transfer to water-side surface area have important bearing on the use of extended surface. Extended surface will increase the rate of surface contamination in some cases and will always make cleaning more difficult; therefore, the fouling tendencies of the hot fluid place definite limitation on the use of extended surface.

For any given fluids and type of surface, the factors limiting the heat transfer coefficient are pressure loss, erosion and circulation of water. Mass velocity is a parameter common to pressure loss and coefficient of heat transfer. The literature contains a great quantity of information on these subjects.

Boiler Arrangement

Having selected type of boiler and surface, preliminary determination of the surface requirement is made. Next, an arrangement is devised to suit the application giving consideration to all of the factors involved. Simplicity of design, standard methods of manufacture, access for repair and maintenance, and freedom from operating difficulties are the specifications for a good arrangement. The authors explain details of design in the paper.

Fire Tube Boiler

A simple horizontal fire-tube boiler, Fig. 5, was applied in an ammonia synthesis process to cool the reformed gas prior to its compression for further processing. Steam is generated at low pressure for the reforming operation, so the boiler application is an economy measure. The gas is clean and non-corrosive to steel. It enters the boiler at 1255 F and at 5 psig.

The relatively low temperature and cleanliness of the gas would indicate that extended surface might be used to advantage, but analysis showed that a high mass velocity could be

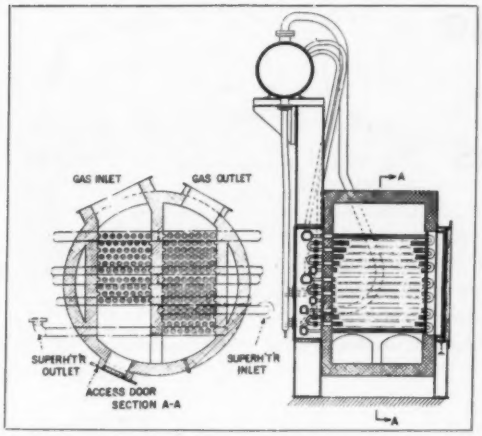


Fig. 2. This water-tube boiler employs extended surface and horizontal hairpin bent tubes, series-connected in parallel groups for reasons given in text

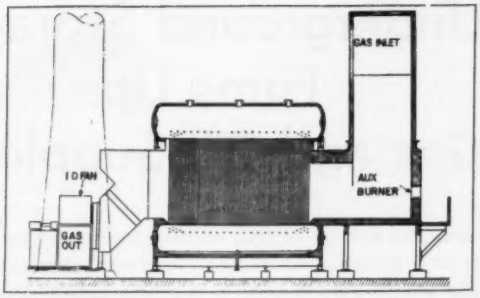


Fig. 3. Common arrangement of water-tube type boiler for heat recovery from the clean process gases at approximately atmospheric temperature

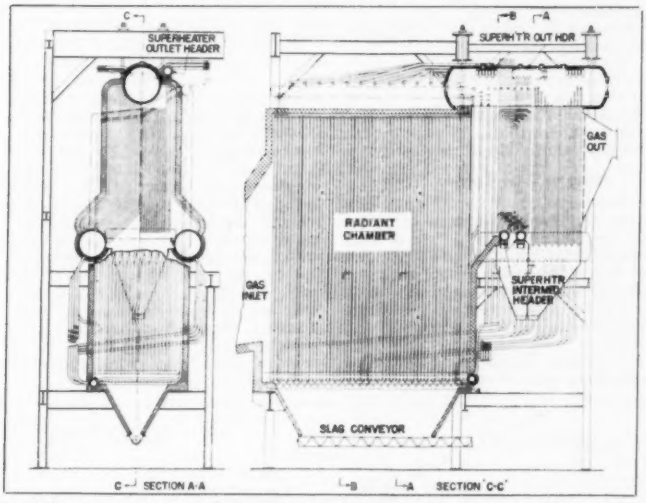


Fig. 4. Special water-tube boiler for recovering heat from reverberatory furnace in copper smelting. Gas may contain liquid droplets, which freeze in suspension in large radiant chamber and drop out

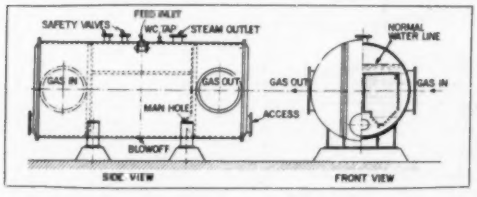


Fig. 5. (Left) Horizontal fire-tube boiler, for use in ammonia synthesis process to cool reformed gas prior to its compression for process

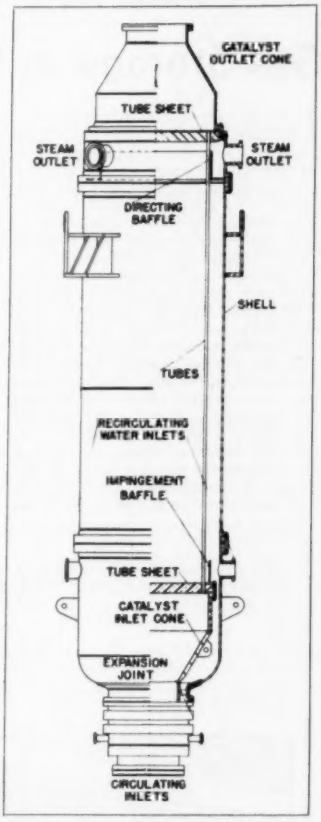


Fig. 6. Special fire-tube waste heat boiler—this catalyst cooler is for fluid catalytic cracking unit

used and that a relatively high gas film rate of heat transfer would result. This made the value of extended surface questionable.

Low steam pressure permitted the steam separation space to be incorporated in the shell, with the tubes fully submerged for full effectiveness in the horizontal arrangement. Gas connections were located at the sides of the vestibules to provide for tube removal without disturbing the gas ducts.

Steam going to process without condensate return calls for careful attention to water control. There is little danger of tube failure from scale formation, but performance would be affected.

Figure 3 illustrates a common arrangement of the water-tube type employing an upper and a lower drum connected by a bank of vertical bent tubes. This arrangement is used for application to heat recovery from flue gases at approximately atmospheric pressure, free of slag-forming contaminants or corrosive products, and for high or low steam pressures

(*Continued on page 128*)

Underground Storage Firms Up Gas and Oil Supplies

Successful storage of gas, oil and gasoline underground is now a reality. In Illinois, a method has been developed for pumping gas underground in wells to a porous sandstone layer in a dome rock formation. In Sweden, oil and gasoline are stored in old mines and blasted-out rock cisterns successfully by methods shown

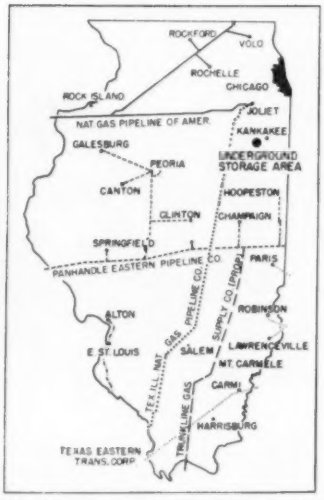


Fig. 1. Map of the natural gas pipe lines serving Illinois and showing location of the storage area

Gas Storage in Illinois

TESTS now nearing completion indicate that the underground gas storage experiment conducted by the Natural Gas Storage Co. of Ill., an affiliate of the Peoples Gas Light and Coke Co. of Chicago, can be successfully developed. As a result, they have made application for Federal Power Commission certification of a $36,200,000 underground project in Kankakee and Iroquois Counties, Ill.

The plans call for storing the gas in an anticline or "dome" rock formation similar to that shown in Fig. 2. The gas will be pumped down to a porous sandstone stratum about 1600 feet below ground level, that at present contains salt water. It will be confined top and bottom by an impervious layer of shale and at the outer edges by the salt water it displaces. It is estimated this reservoir will hold 90,000,000,000 cu ft of gas and will be under approximately 15,000 acres.

Initially 25 wells will be drilled and a total of 50 when completed.

Basic reason for this type of project is to have a gas supply sufficient to meet peak requirements by storing the gas at off-peak times during the warm months. In the off-peak period, demand is only 25 per cent of peak.

Where Gas Comes From

At present, there are two pipe lines from the Panhandle area of Texas to the Chicago region with a daily transmission capacity of 523,000,000 cu ft. A third line from the Gulf coast area of Texas to be in operation after the first of this year will have an initial daily capacity of 383,000,000 cu ft of which 75 per cent will be delivered to Peoples Gas and other utilities in the Chicago area. The remainder goes to other utilities in Illinois as well as other states. However, these three pipe lines without storage facilities are not adequate to meet all requests. Manufactured gas has to be added to meet the demand. A total of nine pipe lines would be necessary at peak times. These additional six lines would cost over $1,000,000,000 which is more than the users could afford. As previously stated, during the off-peak times the demand drops to 25 per cent of the peak load. From these facts it is easy to come to a decision as to which system is the most economical.

Effort will be made to have the reservoir completed and in operation some time in 1953.

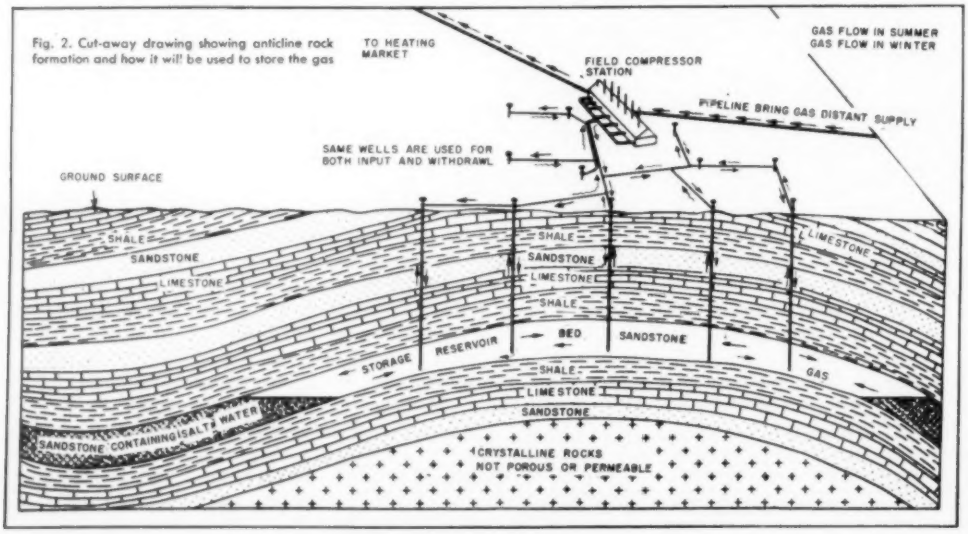


Fig. 2. Cut-away drawing showing anticline rock formation and how it will be used to store the gas

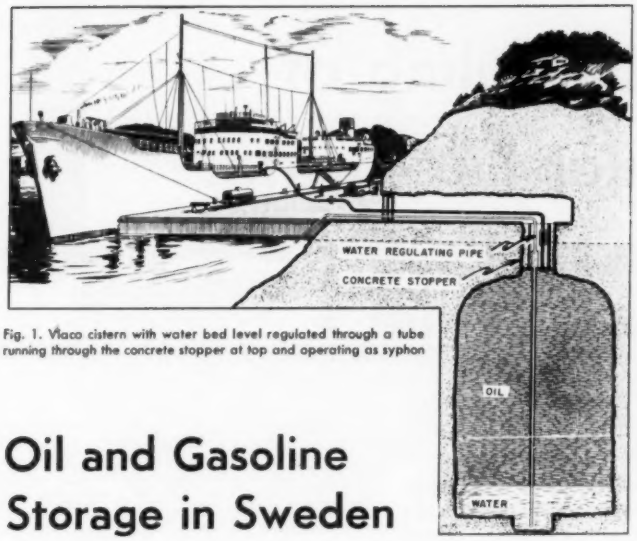


Fig. 1. Viaco cistern with water bed level regulated through a tube running through the concrete stopper at top and operating as syphon

Oil and Gasoline Storage in Sweden

IN THE EARLY post-war years, the Swedish Power Board had the problem of obtaining sufficient storage space for the large quantities of fuel oil needed for their steam plants. Swedish engineer and inventor, Harold Edholm, hit upon the idea of using old mines for the purpose. Small-scale experiments confirmed his theory that oil could be stored on water and subsoil water could function as an effective caulking medium.

An old feldspar mine on the Swedish east coast was found suitable for the purpose. It was cleaned of loose stone and covered by a heavy concrete roof. A separate water shaft was sunk and connected with the lowest point of the mine. This was connected with the nearby bay through a pipeline. A pump and heating station situated 98 ft down in the mine was connected with a pipe line to a tanker pier with a small pump house on it. Oil is stored to a depth of 262 ft. When the depot is completely filled, there is only a shallow layer of water at the bottom. This layer is raised as the oil is pumped out. If for any reason the mine should have to be completely emptied, a special skimming flume is used for removing the last inches of oil from the water bed. This prevents water from getting into the pumps.

Preserves Heat of Oil

A thermometric system permits the central reading of the temperature of the oil at 32 different levels. The oil is delivered into the cistern at 86 to 95 F. It has been found that after a long storage period it does not go below 59 F. Thus, when the oil is to be delivered it requires very little warming.

The warm oil at delivery-level largely cleans itself of water and impurities, which gradually sink to the bottom. Because of the high degree of purity of the oil, no cleaning of the usual filters installed ahead of the pumps has been found necessary.

Water Content Reduced

Control tests made during the period the storage system has been in operation show the water content of the oil taken out of the mine is lower than that of the oil put in. Water pumped from the mine has a slight chemical odor but contains no oil and causes no oil film when discharged into the nearby bay.

$6,000,000 Saved in 3 Years

Including machinery, pipe lines and pier, this plant has cost $700,000 as compared with $4,200,000 for an underground steel tank depot of the same volume. Excluding expenditure for the pier, the cost per cubic foot of storage volume amounted to only 14 per cent of that for ordinary underground cisterns. Maintenance costs have been exceedingly small. The large capacity allows purchases to be made when prices and freight rates are most favorable. It is estimated this first Edholm depot has already saved the owners approximately $6,000,000.

Gasoline Storage

This method is also adaptable for storing gasoline and light oils which are unmixable with water. They rest on a layer of water, which — and this is one of the technical difficulties — has to be raised or lowered to keep the cavity completely filled. This method has been patented in several countries under the name of Viaco cisterns. Of interest is the fact that the subsoil water dripping through the gasoline absorbs some of its resins and sulphur and the end result is a better product.

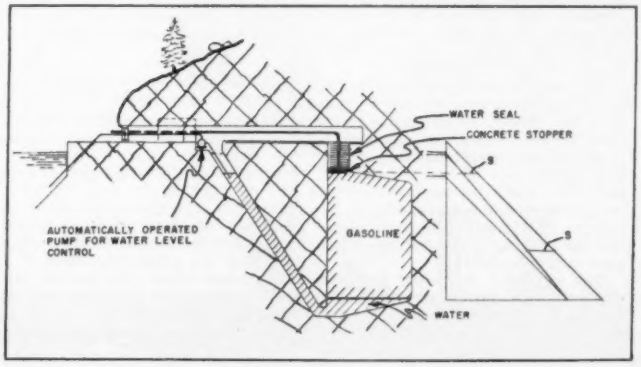
Costs Cut 65 Per Cent

The costs of constructing a Viaco cistern generally intended for large depots of 100,000 to 1,000,000 cu ft, are, of course, higher than those for ordinary surface steel tanks. On the other hand it is cheaper than the systems heretofore used for underground steel or concrete storage tanks placed in the rock. The annual storage costs are, however, only 30 to 40 per cent of those for surface tanks.

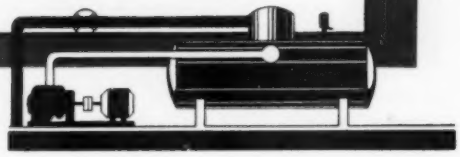
Summary of Advantages

The advantages can be summarized in the following main points: (1) lower annual storage costs, (2) unlimited storage period, (3) no leakage, (4) no losses through evaporation, (5) oil and gasoline clean themselves, (6) bomb, fire and explosion proof, (7) low heating costs for heavy oils, (8) heavy oils always ready for delivery, (9) no steel plate needed.

Fig. 2. Viaco cistern with water level controlled through a separate water shaft which is connected with the bottom of the tank. The automatically operated pumps keep the system balanced at all times



Electric De-Oiling of Your Boiler Feedwater



By **GEORGE S. EMMERSON**

College of Engineering, University of California

In past issues the author has told you about oil in your boiler feedwater, how it gets there, how to filter it out, how to de-oil the feedwater chemically. Now he tells you how you can do it electrically

ELECTRICAL PHENOMENA have been applied to the separation of emulsions of both oil-in-water and water-in-oil with considerable success. In the separation of condensate emulsions, only two distinct principles have so far been applied. One, a system operating on electrolytic or electro-chemical principles developed by Davis-Perret, and the other, a system operating on the principle of cataphoresis, developed by Dijxhoom. This latter operates on the principle that a great number of substances when suspended in water in the form of extremely minute particles tend to migrate to one specific pole of an electric field applied to the system externally. This migration phenomenon is exhibited by two-phase emulsions of oil and water. In the breaking of emulsions of the reverse kind, i.e., water-in-oil, as encountered in oil field work, there have been hundreds of patents taken out in the last thirty years utilizing the various electrical effects. These methods are of great interest and are extensively used. It may be of value, before discussing electric de-oiling, to consider the more diverse methods used in electric de-hydration.

The electric de-hydration of water-in-oil emulsions may be carried out by either direct- or alternating-current. In the former, cataphoresis is produced with consequent separation and coalescence of the droplets of emulsified water. In the latter, there is coalescence and accelerated gravity separation, without cataphoresis, under the electrostatic inductive influence of the a-c field.

The emulsion is passed between electrodes. In the d-c process, these are placed about half an inch apart and maintained at a potential difference of about 250 volts. Cataphoretic migration of the drops of emulsified water towards an electrode is thus induced, leading to the coalescence of these globules and their subsequent gravity separation or filtration. The current varies from three to five amperes, some electrolysis therefore takes place. In the a-c process, there is no steady migration from one electrode to the other since the field is continually reversing. The emulsified globules in this case arrange themselves along the lines of greatest intensity. This electrostatic field intensity varies as a result of the irregular distribution of the water globules which alters the dielectric constant of the material in the field from point to point. Under a high potential a-c field each dispersed water particle, being conductive, is charged by induction as long as the

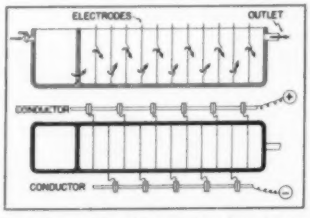


Fig. 1. Parts of David-Perret electrolytic de-oiler

field persists. The charged droplets line up between the electrodes with oppositely charged portions of the adjacent droplets producing a mutual electrostatic attraction which ruptures the separating films of oil and brings them into contact with one another. The joining of adjacent droplets continues until the coalesced drops are large enough to separate from the oil by gravity. The intensity of the field, of course, varies with the proximity of the electrodes, and the viscosity of the oil forming the continuous phase may retard coalescence. The many versions of this principle, therefore, are primarily aimed at attaining the most effective means of overcoming the viscosity of the oil. Difficulty is often experienced, too, with the short-circuiting of the electrodes due to the formation of conducting bridges of suspended water droplets. Very often, even if every second or third half-wave is omitted in the current supplied to the electrodes, no appreciable improvement in the separating effect can be obtained. It is, therefore, difficult to get a field of sufficiently great intensity. The introduction of a gas to reduce the conductivity of the emulsion has been attempted with some success, and Heinrich (U. S. Pat. 2000, 018–1935) developed a very interesting method for overcoming this difficulty as follows:

> Uni-directional voltage impulses having a duration of only about ten seconds or less are impressed upon the electrodes at intervals which are very long compared with the duration of the impulse. It is then possible to increase the field strength between the electrodes by 50 to 100 per cent without short circuiting. The reason for this evidently lies in the fact that when an impulse of short duration is followed by a considerably longer pause, the delay in the discharge of the electric field is so great that in spite of the high intensity of the field a complete breakdown between the electrodes cannot develop.

Since the continuous phase in oil-in-water emulsions is water and, normally conductive, the creation of an electric field of adequate potential difference for the effective employment of the methods used on oil field emulsions is thereby prevented. Cataphoretic migration of condensate

Any way you figure it, corrosion of steam and condensate lines is a serious problem . . . and a costly one! Replacement of corroded lines, interrupted production, increased labor and maintenance send costs spiraling far beyond the limits of economical plant operation. But something can be done about it *right now*, with complete assurance of satisfactory results.

Take the case, for example, of a large plastics molding plant which operated the cycle on its molding machines alternately with steam and oxygen-saturated cooling water. Under these conditions, severe corrosion resulted. Check valves on the steam supply lines to the machines had an average life of only one week—*sometimes even less!* Costs were skyrocketing.

Here's what Betz did about it. By applying its patented filming amine treatment, piping and valve losses stopped *immediately!* After three years' treatment with this advanced technique, satisfactory corrosion control continues. What's more, plant records show savings in labor and maintenance have averaged 30 times the cost of the treatment applied.

This is just one example of how Betz Engineers help keep plants *like yours* at peak operating efficiency. Why not get in touch with Betz today as the first step toward solving your particular water problems. There's no obligation, of course. W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa. In Canada: Betz Laboratories Limited, Montreal 1.

For the full facts and figures on how BETZ is solving return line corrosion problems in plants like yours, write today for Technical Paper No. 124.

BETZ

CONSULTANTS ON ALL WATER PROBLEMS

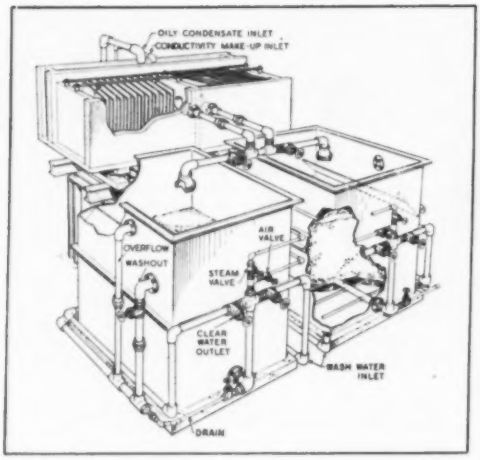


Fig. 2. Arrangement of electric de-oiling plant

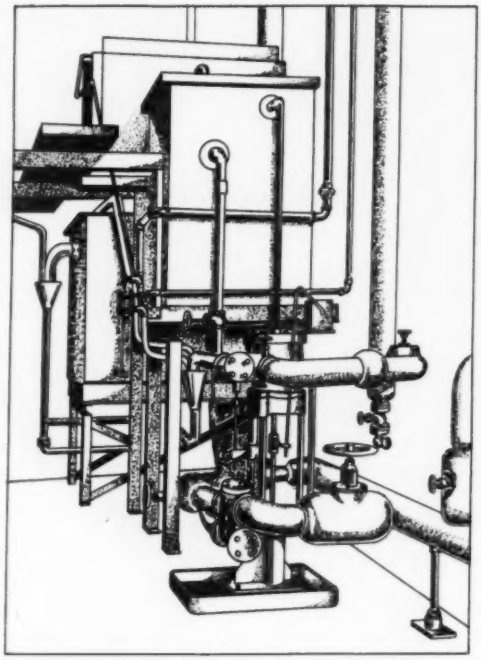


Fig. 3. Small electric de-oiling plant installation

emulsions under the influence of a d-c field has, nevertheless, been attempted, though the idea has not gained any favor. Dijxhoom, a Dutch engineer, took out a patent (Le Papier 22, 53–1919) which involves subjecting the condensate to a potential difference of 110 volts as it passes through the feed pipe. The oil globules migrate and coalesce into larger drops and are finally eliminated by an ordinary absorption-type filter.

In contrast, the electrolytic device patented by Davis-Perret (Br. Pat. 10,874–1902; 8175–1903; 26,577–1908) has been greatly used. In this system, the condensate is directed in a zig-zag path through an insulated tank by iron baffles which also act as electrodes. The process involved is, in essence, the production of ferric hydroxide by electrolysis, which coagulates the oil as described in the article on Chemical De-oiling of Your Boiler Feedwater in the July, 1952 issue of POWER ENGINEERING. The coagulated oil appears as rusty colored flakes which are easily removed from the water by ordinary filtration. Whatever the nature of the electrolyte, a basic salt is always produced on account of the alkali formed at the cathode. The action is primarily electrolytic, and any cataphoresis is merely incidental.

In order to increase the conductivity of the condensate, it is necessary to add a suitable impurity, sodium carbonate has been most used, though a great deal will depend on the nature of the feed water treatment and plant design. The apparatus operates best with hot water, such as steam engine condensate. The original Davis-Perret patent is discussed below.

The essentials of the Davis-Perret de-oiling device are shown in Fig. 1. A number of sheet metal (preferably iron) electrodes alternately connected to the two main conductors are contained in a tank constructed, or lined, with some insulating material. The electrodes are formed with openings alternately at top and bottom for the purpose of causing the water to take a circuitous path while being subjected to the electric current. The oily water is first admitted to a compartment where its conductivity may be adjusted by allowing a quantity of sodium carbonate, potash solution, or raw water, to enter by the cock shown in the drawing. The container could be varied in design and in some cases, act as an electrode.

The electrodes are found in practice to last about three years, and an initial oil content of 50 ppm could be reduced to less than 1 ppm. However, the prototype device has been improved upon and a number of refined designs have been produced commercially, one of which is described as the modern electrolytic de-oiling plant.

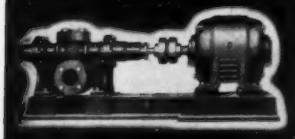
Electrolytic De-oiling Plant

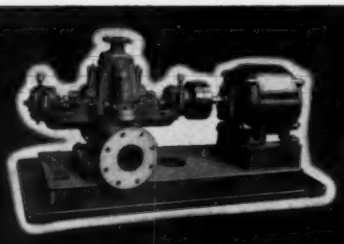
The arrangement of a modern electrolytic de-oiling plant produced by Filtrators Ltd., London, England, is shown in Figs. 2 and 3. The iron electrodes are contained in a tank normally constructed of British Columbia pine. This tank is of sufficient size to ensure the oily condensate takes at least eight minutes to pass through it to a granular bed filter. Two filters are usually employed to operate a duplex system and so ensure continuous filtration. The potential difference between the electrodes is 100-v d-c for a plant capacity of less than 10,000 lb per hr and 200-v d-c for greater capacities. Where the mains supply is a-c a rectifier is used to provide d-c.

Since conductivity of about 50 micro-ohms is necessary in oily water to permit satisfactory operation of the apparatus, suitable inorganic salts are introduced by way of the conductivity make-up inlet. The requisite concentration is of the order 35 pm, and this is usually achieved by adding softened raw water, or boiler blow-down water, caustic soda, trisodium phosphate, or other boiler water conditioning agent. The electric power used varies with conditions, decreasing as the temperature of the condensate rises above 120 F. In general, however, about 0.5 kwh of electric energy is required for the treatment of 10,000 lb of condensate.

One of the great advantages of this equipment is the degree of automatic control attainable. A float switch is attached to each filter, and when the head of water above the filter bed rises to the level of the overflow — indicating the need for cleaning — the switch is operated and the treated water is directed to the standby filter. The conductivity of the water is controlled, and various safety devices are easily incorporated. Single units vary in size from about 2000 lb per hr to 30,000 lb per hr, and in very large installations, it is found most convenient to employ a number of single units of 25,000 lb per hr capacity. The plant installed for the Shell Refining and Marketing Co., at their new refinery at Stanlow, Cheshire, England, is designed for the treatment of 450,000 lb per hr.

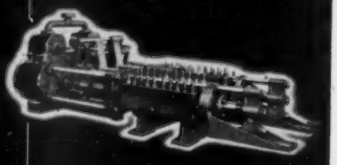
Warren-Quimby
Gear-in head Screw Pump





Warren Condensate Pump

Warren Horizontal Duplex
Hydraulic Pump



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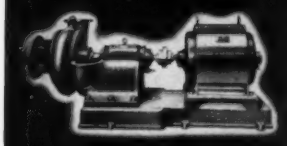

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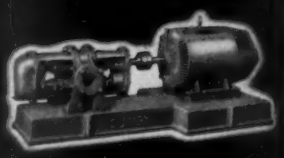
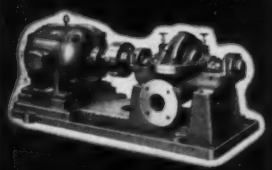
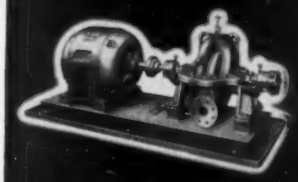


Warren-Quimby External Gear
and Bearing Rotex Pump



Warren Type DBL, Single-Stage
Double Suction, Centrifugal Pump



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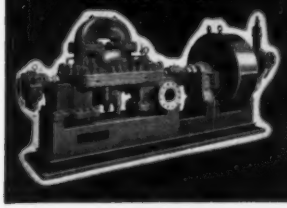
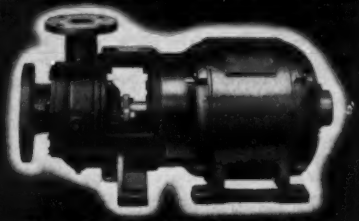
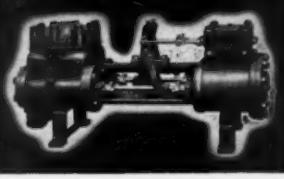




Warren "Compacunit"—4 Types—42 Sizes

Warren Horizontal "Realwear"
Duplex Piston Pump



By **J. G. MINGLE** Superintendent
Bureau of Air Pollution Control,
City of Indianapolis, Indiana

More Slants on SMOKE

EXCELLENT ARTICLE, New Slants on Smoke, by Paul A. Dobbs, May issue POWER ENGINEERING, convincingly brings to attention some of the problems of operating engineers in their contacts with air pollution control officials. Air pollution control officials also have problems in dealing with heating and power plant personnel. Most sensible manner to solve these problems is for both to hold a conference at the offending plant in a cooperative attempt to reach common ground. Objective of the great majority of air pollution and smoke control officials is to assist in every way possible to get unlawful emission of an offending stack under control, and not to harass operating personnel. Most plant operators attempt to abide by smoke ordinances, but a few become irritated and annoyed by frequent citations for infractions. Conferences should settle these matters.

Operation of jet stacks in emitting columns of black smoke at high velocities is, in my opinion, an exception rather than the rule in most cities. Answer, of course, is to prevent formation of smoke of initial density that results in violation in a more concentrated form. In a properly designed and operated plant, including the stack, there should be no occasion for unlawful emission of smoke except when building or cleaning a fire, or blowing soot.

Practically all anti-smoke ordinances allow reasonable exceptions for these necessary operations. If more time is required than the ordinance permits, the problem should be approached from a practical viewpoint and the ordinance amended. In attacking all smoke problems, solution in most cases lies in controlling density of the stuff emitted by the stack rather than restricting the kind of fuel going into the furnace. Under improper operating conditions, fuel oil and gas produce smoke as black as that from coal.

Use of Overfire Air

Most smoking stacks can be effectually cleared up by overfire air, either steam-air or motorized blower systems. Steam jets abate smoke by providing turbulence in the furnace and by decomposing hydrocarbons of volatile matter into oxides of carbon and hydrogen, all of which are colorless gases, but which may not be

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In New Slants on Smoke, May issue, Paul A. Dobbs offered some convincing reasons why current smoke-abatement practices by both industry and the community are often unrealistic. He advocated a merit rating system to prevent unjust penalizing of jet-stack owners and others, better understanding by smoke departments, more overfire air, and conscientious combustion techniques by industry.

This month, because of great interest aroused by Mr. Dobbs' article, we present further comments by J. G. Mingle on anti-smoke ordinances and practices from a different point of view — that of an air pollution control official of a large industrial city. Mr. Mingle likewise stresses the use of overfire air, and, in addition, urges cooperation and understanding between smoke officials and potential smoke producers. He also says that other pollutants are becoming important!

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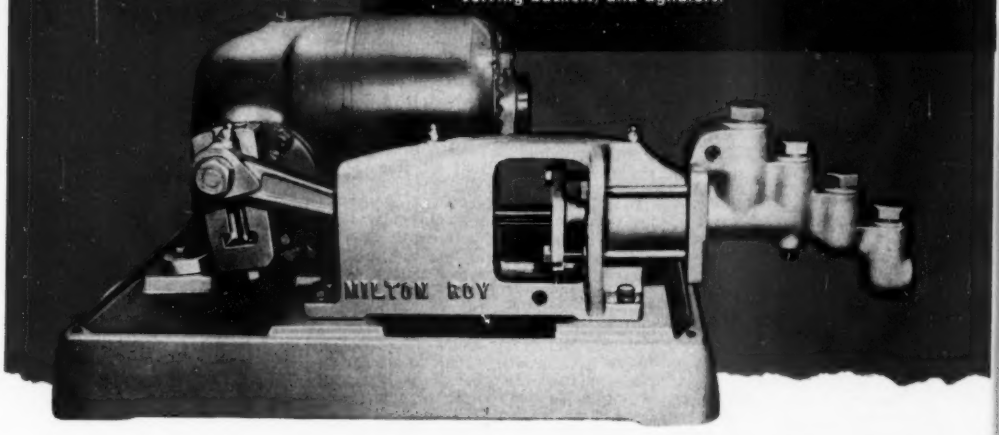

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burned except with sufficient oxygen (air) which a steam jet by itself does not supply. A steam-air jet provides turbulence, decomposes hydrocarbons into carbon monoxide, carbon dioxide and hydrogen, and also supplies necessary air for combustion. A motorized blower of sufficiently high pressure provides turbulence and supplies air for burning all combustible matter.

Curing the Disease

One of the great mysteries of all time is how a fuel-burning plant can be expected to operate smokelessly without employment of overfire air under pressure. The very fact that steam-air jets and motorized blowers can prevent formation of smoke in almost any plant is sufficient proof that overfire air is an absolute necessity, and has been all these years. This requirement applies not only to hand-fired but to mechanically-fired plants, particularly spreader stokers. It might be presumptuous to assume that overfire air would solve the problem of the jet stack, but it certainly would be worth a trial if the installations have none. Let it be said that more smoke problems have been solved by overfire air equipment than by all other methods combined.

In fairness to the offending stack, smoke violations should be observed properly and under normal conditions. If the Ringelmann Chart is used as a standard in judging density of smoke, the observer should make his observation no closer than 100 ft from the stack and with the sun at his back. Line of observation should be at right angles to the direction of smoke travel. Smoke density is judged by light reflected from emission particles, not by light that penetrates the smoke plume. Weather conditions influence apparent density greatly. A No. 2 density smoke, for example, may be judged as No. 3 density on a dark, cloudy day. It is obviously difficult to correctly judge smoke density during a rain or snow storm, periods of dense fog or smog, a misty rain, or when the smoke plume is blown to one side of the stack by a brisk wind. Most experienced smoke inspectors become practical and realistic in properly judging smoke density.

Attitude of the violator towards the smoke control official may influence the latter's judgment on smoke density. Some violators become needlessly irritated and annoyed on being cited for an ordinance violation. Unless specifically exempted, every stack in the city should comply with the anti-smoke ordinance without argument. Insofar as smoke abatement or prevention is concerned, there is no middle ground; either the stack does or does not emit smoke.

If the stack emits smoke, cause for noncompliance should be gone into thoroughly and the proper remedy applied. Should the cause be due to the character of the coal burned, then the fuel producer or coal dealer should be called into consultation. A different type of coal, degree of volatility, size, or other factors, may be the solution to the problem. If unlawful smoke is due to defective or improperly maintained equipment, the equipment manufacturer should be contacted. Annual plant inspections by air pollution control officials are of great help in finding these defections. If the smoke conditions are due to improper firing methods, most inspectors will demonstrate how to properly fire the unit. Firing schools are conducted in some cities with commendable results, but in the final analysis there is no procedure more effective than individual firing instructions. If the automatic control system has gotten out of proper working order, the manufacturer should be contacted for services of a field man to adjust the mechanism. In other words, if the wrong coal is being employed, change it; if the equipment is defective, fix it; if the firing is at fault, correct it; etc. Do something to prevent the smoke, but do the proper thing.

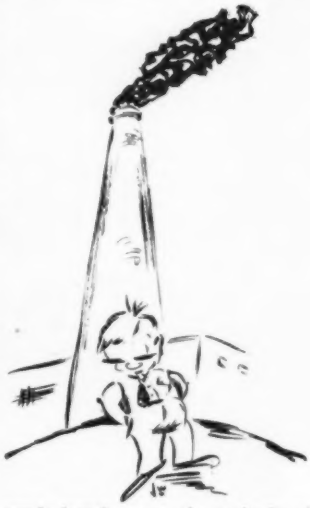
Smoke Violations Diminish

Until comparatively recently, smoke has been the chief object of attack by ordinances and control officials. But this form of air pollution is now well under control, or at least its density is gradually being brought within limitations of anti-smoke ordinances. In most cities smoke is not now a major problem. A fair comparison with "the good old days" proves this statement. Other air pollution factors are fast becoming of importance almost daily. Air pollution conditions that were scarcely noticed as late as three years ago are becoming more aggravating and annoying to citizens. Complainants now literally "howl their heads off" about dust, dirt, lint, chaff, obnoxious odors, burning of garbage, incinerator emissions, and a multitude of others, in addition to the time-honored pollutants soot, cinders, noxious acids, fumes, gases and fly-ash. Reason for this is doubtless due to the fact that the atmosphere of most cities has actually become cleaner, so much so that conditions not even noticed heretofore are now very much in evidence. In other words, people reason that the cleaner the air, the cleaner it should be. This is a good indication that progress is actually being made.

Cooperation Is the Key

Another reason for increasing importance of lesser pollutants is that air pollution control officials are finding more time to investigate and dwell upon them, now that smoke is largely under control. News that certain messes have been cleaned up gets around quickly, and others demand the same attention and service.

The degree of air pollution control, or abatement, gained in any city depends largely upon the attitude of potential smoke producers. If they are cooperative, and not combative, any city can have air as smoke- or pollution-free as it is entitled to. Cooperation is the key word in the solution of air pollution problems and very little of a constructive nature can be accomplished without this much desired business-like method of doing things.



Co-operation in science, engineering and industry has produced the phenomenal productive capacity we have today. It will lead us, not only to a more productive society, but to a cleaner and healthier one as well.

DON'T CLIP THIS ARTICLE

Others in your plant may want to read the complete issue, so if you want an extra copy of this or any other article, ask the Editor for tear sheets or a reprint. For convenience, use the postage-free card that you will find elsewhere in this issue.

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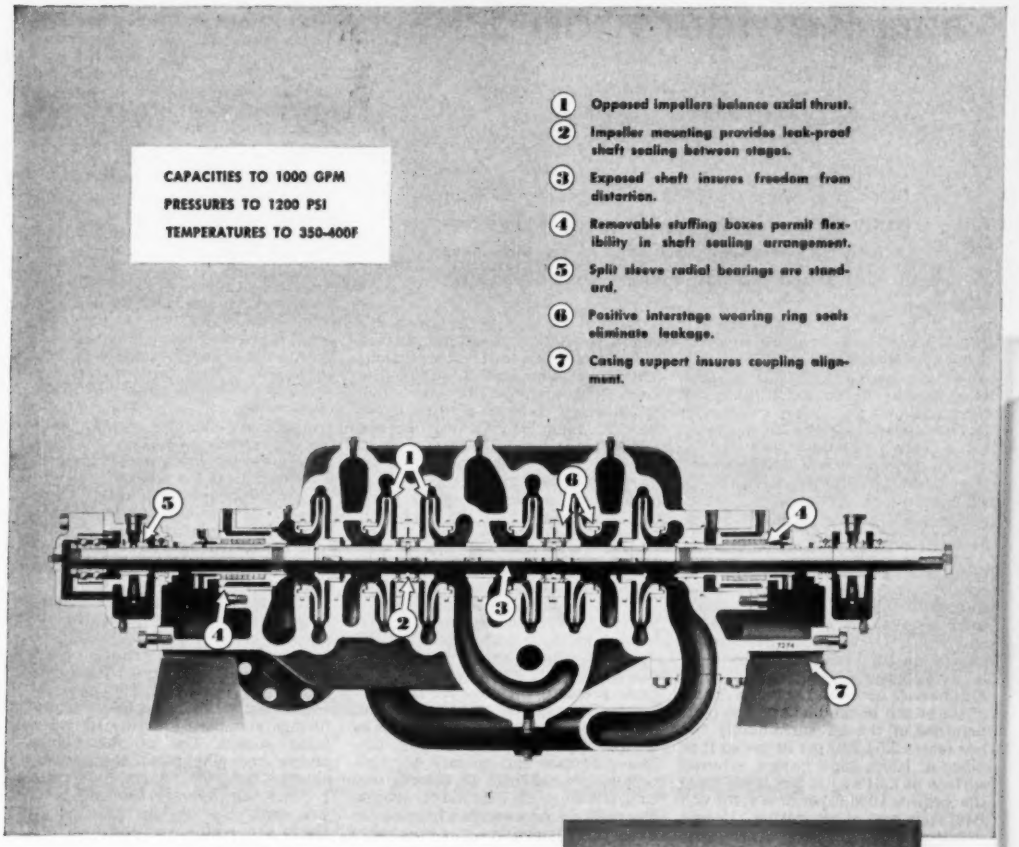
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How We Saved Power and Refrigeration $$$

By A. T. LOHKAMP
Steam and Refrigeration Engineer
Pasco Packing Company

There are many ways of saving money in your power plant. Here are the facts and figures concerning this engineer's activities to do this. Here is what he did and how much he was able to save

IN MANY of the smaller industrial plants, conditions probably exist which are costing thousands of operating dollars every year. Many of these dollars are being needlessly thrown away, because of laziness, while others may be wasted due to short-sighted policies of management. The following are a few ways in which we have saved money in our power plant during the last seven years:

First in importance has been the insulation applied to steam-main and condensate-return lines. We have thousands of feet of these lines which, prior to 1945, were all uninsulated and a resulting great loss of heat. As an example; a 10-in. steam line 1000 ft long without insulation at 200 F difference between the temperature of the steam in the line and the temperature of the air surrounding the line looses 2.54 Btu per hr per sq ft of pipe. A 10-in. pipe has an external surface of 2.817 sq ft per lineal ft so the loss in a 1000 ft per hr is 1,431,036 Btu. At a cost of generating 175 psig steam of $0.60 per 1000 lb, the cost per million Btu is approximately $0.61. The cost of this loss per hour is $0.87293. With standard weight 85 per cent magnesia pipe insulation, the loss is cut to 0.323 Btu per sq ft per hr per deg temperature difference, or the loss amounts to only $0.111 per hr on 1000 ft of 10-in. pipe. The savings then are $0.76193 per hr by insulating the line. The cost of insulation on this size line is approximately $1.90 per lineal ft or $1900 per 1000 ft. The insulation paid for itself in savings in 104 days of operation. After it has paid for itself the insulation will return an interest of $18.29 for every day this 10-in. line carries steam or 351.36 per cent interest per year on the invested capital of $1900.00.

In our plant we also have hundreds of feet of steam lines 12 in. or larger, and literally thousands of feet of smaller sizes. The insulation on these lines have not only saved thousands of dollars, but have enabled us to turn out more product with the existing boilers. I have heard of plants having so many exposed, uninsulated steam lines that added boiler capacity had to be purchased to supply the losses. This undoubtedly sounds like a fish story, but in our particular case, it would be true had we not added insulation on the steam lines.

Where a lot of steam is used for process heating, great economy can be affected in many cases by using exhaust steam from auxiliary turbines or from turbines driving generators as a source of this heat. This method will give a lot of power at the lowest possible cost.

We have installed a non-condensing turbine for power generation and have some of our boiler room auxiliaries with duplex drives so that we can drive with either a motor or a back pressure turbine. At times of low requirements on the process steam we make as many kilowatts as we can on the non-condensing turbine-generator and operate our fans and other auxiliaries by electric motors, but when the demand for process steam increases we switch from motor drive to turbine drive on a number of auxiliaries to save kilowatts and meet the process steam requirements.

Power Factor Improvement

Several years ago we found that our generators were being handicapped in output due to low power factor. The generator capacity was limited by high amperage so that a 1500-kw generator could not generate over 1300 kw. Our 1000-kw generator was limited to about 900 kw. Since our demand for electric current exceeded our generator capacity we had to purchase a lot of power from an outside source. By installing capacitors to increase our power factor we have been able to carry full load on both generators at a saving of approximately $0.006 per kw over buying the 300 kw we were losing in capacity due to low power factor. This saving amounts to $43.20 per day or $11,664.00 for a 270 day operating season. The original cost of the capacitors was repaid in approximately 148 days of operation.

Capacitors have proved their worth in other ways also. Aside from the actual cash savings in this instance we found that motors were running cooler at the ends of fairly long transmission lines; more motors could be added without overloading the lines and in one case, additional motors were added to a line which would have required replacement had we not had the capacitors. In general, the capacitors were installed as close as possible to the points of power usage.

Small Items Save, Too

By following the above procedures we eliminated the larger and most apparent sources of waste and then started looking for some of the smaller items. By calling in a water consultant's field engineer on our water conditioning problem, we were able, by following their recommendations, to cut the time required for turbining tubes and cleaning our boilers to about 20 per cent of the time originally required. This amounted to a saving of about $1500.00 per year in labor plus the advantages of cutting down the wear in boiler tubes from turbining and prolonging the life of the boiler tubes by preventing overheating of the metal caused by scale formation within the tubes. Good water treatment and prevention of carryover saves money on turbine blade replacements and on heating.

We went a step further and started using filming amine treatment to prevent corrosion in condensate return piping. Prior to the use of this filming amine we had to replace condensate piping almost every summer. Sometimes we had to replace threaded fittings and piping during the operating season. Use of the filming amine has eliminated these costly shutdowns.

Since our average makeup is 59 per cent, the savings affected by using the amine treatment do not stop with just pipe and labor, but go on to include the savings of condensate and heat (condensate is returned at 208 to 290 F), which becomes an appreciable item in our operation.

We installed a continuous blow down system with a flash tank for our boilers so that we can maintain constant solids concentration in the boiler water and reduce the rate of blowdown. The flash tank allows the blowdown water from the boilers to flash to steam at 5 psig for use in feed water heating. A constant water level is maintained in the flash tank by means of a float valve which dumps the water to a heat exchanger.

The blowdown rate of the boilers is approximately 3 per cent which means that for every 1000 lb of feed water entering the boiler, 30 lbs of water leaves as blowdown water. Of this 30 pounds, 15½ per cent or 4.65 lb are flashed to steam and used for feed water heating in our 18,000 gph water softener. The remaining 25.35 lb of water at 228 F formerly dumped

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to the sewer is now dumped into a heat exchanger by the float valve where the water going to the water softener flows through the tubes in the heat exchanger. The blowdown water surrounds the tubes. By this method all possible heat is taken from the blowdown water before it is dumped to the sewer.

Now, since it is an established fact that for each 11 deg of heat added to the feed water, approximately 1 per cent of fuel is saved, we started looking for another means of preheating the raw water before it entered the softener. Another, almost ideal source of heat was the discharge water from the condenser under our 1500 kw turbine. This leaving water was at 90 F or above. Why not use it for supplying the make-up water to our water softener? We did! This actually added 16 F of heat or 16 Btu per lb of water or a saving of approximately 0.85 per cent in fuel oil cost. On an average fuel consumption of 41,675 gal per day, this saving alone amounts to 420 gal or 10 bbl of fuel, which at $2.38 per barrel amounts to 10 x $2.38 or $23.80 per day.

Our deep well water averages a constant 74 F as pumped. The turbine condenser discharge water at 90 deg has added 16 deg to this and as this water enters the softener through the heat exchanger, the make-up water actually enters the water softener at an average of 108 F or 34 deg above well water temperature. This savings in actual Btu saved (at $0.61 per million) amounts to an average of $1811.65 per month of operation. These two sources of waste heat have paid for a $34,500.00 expansion in our water softening plant in 2.116 operating seasons and are now returning an interest of 47.26 per cent on the capital invested in the expansion.

Refrigeration System

Another excellent economy measure is an automatic air purge on our ammonia refrigeration system. A decrease of 2 lb in discharge pressure will save approximately one per cent in power consumption. By keeping the high pressure compressors discharging at a pressure equivalent to the condensing temperature, a lot of power can be saved.

Many plants depend upon manual purging to keep the condensing system air free. An automatic purge unit removes the human element and assures keeping the system free of noncondensible gasses so that it will operate at the lowest possible head pressure at all times. The automatic purge will probably require some attention from the maintenance crew to keep it in top operating condition, but unless an unusually large amount of air is entering the system, the maintenance work can be done without interrupting operation of the system.

Scale or slime and algae in the water side of ammonia condensers often cause extreme discharge pressures. Condenser tubes can be mechanically cleaned with brushes and tube cleaners, but this method is not nearly as effective as acid cleaning. One of the chemical cleaning service companies has done a very excellent job of acid cleaning our turbine and ammonia condensers. Acid cleaning our ammonia condensers has really paid dividends. Here is how it worked for us:

Acid Cleaning Methods

We had an average discharge pressure of 162 psig on our high pressure ammonia compressors for the 1950–51 season of operation, which was approximately 20 psig above what it should have been. We had cleaned our ammonia condenser tubes during the summer of 1950 with tube cleaners and brushes so that we thought the tubes were cleaned. During the summer of 1951 we had the cleaning service company acid clean the ammonia condensers. Our discharge pressure on the same compressors during the 1951–52 operating season has averaged 145 psig which is an average of three pounds higher than it should be. The same air purge unit has been used at all times and operating conditions have been, if anything, worse this season, but still we have a head pressure of 17 lb less or a saving of 8.5 per cent on horsepower.

Let's see what this amounts to when figured for 400 hp, which is approximately the horsepower we are operating on compressors discharging to the condensers under discussion. This 400 hp would use approximately 320-kw per hour, and 8.5 per cent of this would be 27.2 kw saved. This amount (27.2 kw) at $0.0145 amounts to a saving of $0.3944 per hour. During an operating season of 240 days on heavy load while processing frozen orange concentrate this saving amounts to $2,271.74. During the rest of the year at light load of approximately 94 hp the saving amounts to $277.96. The total savings will then be $2,549.70 for the year. The cost of cleaning was about $700.00. I say *about*, because the cleaning job was a part of an acid cleaning job involving quite a lot of other equipment.

The above should not be misunderstood to the extent that these results can be obtained in all cases, but results depend upon amount of scale and deposit present and size of the job. However, clean, air free condensers will always save money.

While discussing acid cleaning, it might be well to mention that we also had four large open type cookers acid cleaned to remove the scale and deposit from the outside of the steam heating coils. This cleaning has resulted in a saving of $4,859.18 in cost of producing canned grapefruit sections. Most of this was saved due to a shorter required warm-up time on these cookers and an evener temperature in the tanks. This season's temperatures were at times curtailed because of insufficient heating. This will illustrate the type of savings that can be made by having the cleaning company do a thorough acid cleaning job on condensers, cookers, heating coils, etc. Savings on the per case basis were made at $0.007 per case, but on 694,169 cases, this amounts to $4,859.18.

Cleaning Water Softeners

Acid cleaning of the anthrafilt in our filters for the water softener effluent resulted in saving the price of a new charge of graded anthrafilt for each of five filters. This saving amounted to $900.00 plus labor of removing the dirty, partially clogged filter beds and replacing them with new anthrafilt. Allowing $150.00 for labor, this brings this saving to $1,050.00. Having our turbine condenser acid cleaned has resulted in a higher vacuum and steam savings there.

The total cost of acid cleaning our 18,000 gph first stage water softener, our chemical tanks, four large cookers, two small heating tanks, turbine condenser, four ammonia condensers, and five water filters was $4,956.00. Savings resulting from this cleaning amounted to $8,458.88 plus time and labor saved in cleaning the chemical tank, large water softener and turbine condenser. Since we have no way of checking accurately on the amount of steam saved on the turbine, I have not attempted any calculation as to savings there.

Westinghouse Steam Division Will Build $6,000,000 Laboratory

GROUND was broken recently for a $6,000,000 steam and gas turbine development laboratory at the South Philadelphia Works of the Westinghouse Electric Corp. Actual construction of the four-story, brick and structural steel building will begin late this summer, and will take about a year to complete. It will employ a staff of nearly 100 engineers and technicians, and initially will conduct special research for the U. S. Air Force.

Steam and gas turbines and their components up to 15,000 kw capacity will be accommodated in the main test hall of the new research building. Three 8,000-hp axial-flow compressors will provide facilities for compressor development for gas turbines.

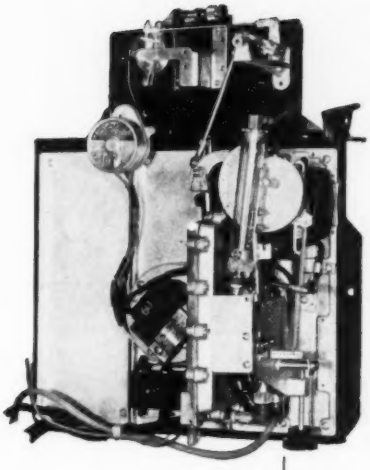
United Engineers & Constructors Inc. of Philadelphia will construct the new building according to specifications developed by the Westinghouse Engineering and Research Departments in Pittsburgh, Pa.

a new low differential flow meter to measure . . .

air flow

gas flow

or air flow-gas flow ratio



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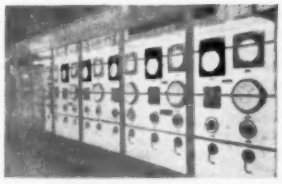
applications



Industrial Furnaces—Diaflow measurement in open hearth, soaking pit, billet, slab heating and annealing furnace indicates excessive amounts of air and/or gas . . . helps to prevent fuel and gas waste . . . serves as a guide in maintaining product quality.

Sewage Disposal Plants—A guide to proper control of sewage treatment processes. Diaflow metering indicates: load on plant, variations in functions, relative rate of fluid flow and a continuing check on costs.

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OPERATING EXPERIENCE

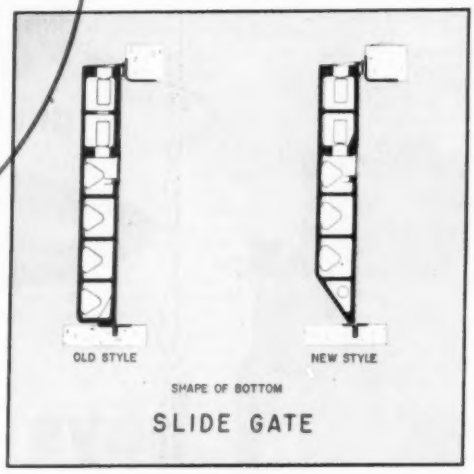


Fig. 1. Slide Gate

By WILLIAM G. WEBER, Engineer
Design and Construction Division
Bureau of Reclamation
Denver, Colorado

. . . with Hydro Plant Valves

What the Bureau of Reclamation has learned in operating high-head (100 ft) cut-off type gates; – slide gates, roller and wheel-mounted gates. Other types discussed later

THIS IS THE FIRST of three articles adapted by the author from his paper before the National Conference on Industrial Hydraulics, at Chicago, in 1950. The articles summarize the Bureau of Reclamation's experience pertaining to the performance, operating characteristics, and maintenance problems encountered in the use of certain gates and valves installed in hydraulic structures designed or operated by the Bureau. These data represent a cross-section of information relating to the application of gates and valves and serve as index of individual performance.

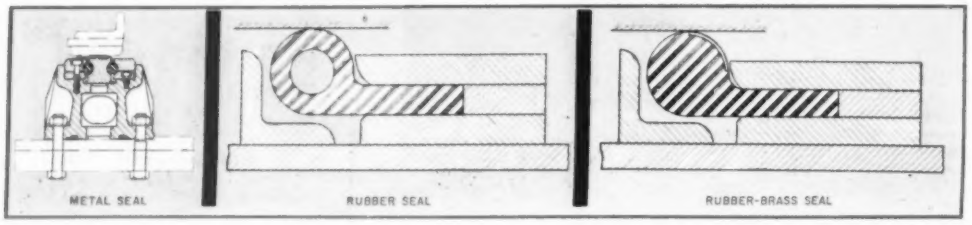
Performance of gates and valves is discussed according to the types of operation. Only high-head gates and valves have been considered. High-head is arbitrarily defined as a hydrostatic head of 100 ft or more. Spillway gates and the gates and valves in the outlet works of low dams are not discussed, for their operating characteristics are well known.

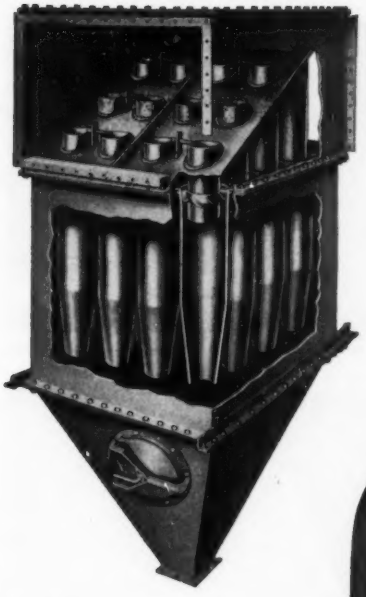
This article discusses briefly the Bureau of Reclamation's experience in the use of transverse cut-off type of gates — those gates in which the leaf motion is normal to the water passageway. The other types will be covered in later articles.

The simplest gates included under the transverse cut-off type are the slide gates. Two slide gates are shown in section in Fig. 1. For the old style type of gate, even at relatively low heads, it has been found that with the gate partly open, there is apt to be a tendency, within a narrow range of part opening, for the control orifice to alternate between the upstream and downstream edges of the leaf, and heavy vibration and development of partial vacuums on the underside of the leaf have resulted. At higher head, cavitation pitting may appear on this underside. Should the gate be left in the critical range of opening for any lengthy period the pitting may reach a stage where the safety of the leaf is threatened.

Figure 3 shows serious pitting on

Fig. 2. Here are some of the typical gate seals used on various valves of the types used by Bureau of Reclamation, as they are discussed in this article





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Uniformly High Recovery: MULTICLONE's multiple *small diameter* tubes—made possible by its exclusive vane design—whirl the dirty gases with greater centrifugal force, thus throwing out not only the large, medium and small particles, but also a high percentage of the *extremely small* particles of 10 microns and less. This, coupled with the fact that there are no pads or filters to become choked with recovered material, results in a more complete recovery of *all* suspended materials from the gas stream.

Long and narrow

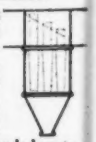
Square

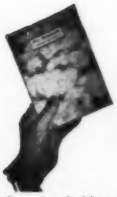
Maximum Adaptability: In addition to its unusual compactness, the MULTICLONE is also unusually adaptable to various installation requirements. Where head room is low it can be installed with side-inlet side-outlet connections. Where side clearances are restricted, it can be installed with side-inlet top-outlet connections. In addition, without changing capacities, the shape of the unit can be varied—long and narrow, short and wide, or square—to fit restricted spaces ...and its single-inlet single-outlet duct requirements permit greater flexibility and simpler installation. These savings slice installation costs, space requirements and insulating expense.

Space-Saving Compactness: Plant space costs money—so be sure to check space requirements carefully. As shown in the accompanying chart, the MULTICLONE requires less floor space and less cubic space than any other unit of comparable capacity and performance. Translate these savings into today's high costs for plant space and you readily see the great importance of this one MULTICLONE advantage alone!

Make	Relative Space Requirements In Sq. Ft.	In Cu. Ft.
Multiclone	1.0	1.0
Collector A	2.1	1.8
Collector B	5.9	3.2
Collector C	6.8	3.9

Minimum Maintenance: The MULTICLONE has no high speed moving parts to repair or replace... no pads or filters to clean or renew... nothing to choke the gas flow or increase draft losses as suspended materials are recovered. MULTICLONE draft losses remain uniformly low *at all times*. Further, the recovered material from an entire bank of tubes is collected in a *single* hopper—far easier to service and maintain than the multiple hoppers of conventional cyclone units.





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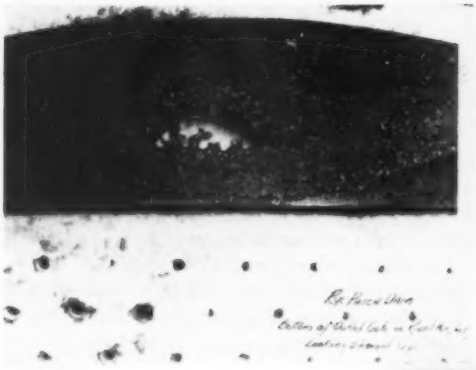

Fig. 3. This view shows pitting on bottom of an outlet gate

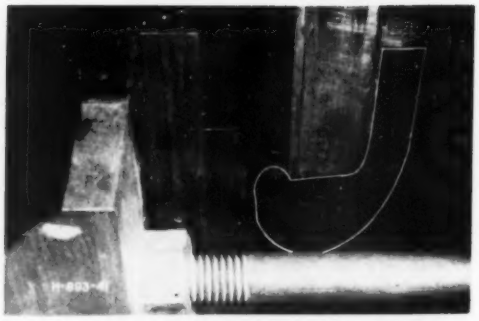

Fig. 4. Results of tests on seal of type of Fig. 2; seal forced out of position

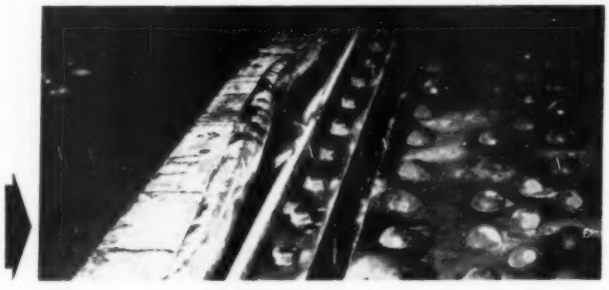

Fig. 5. Bottom seal of one of Grand Coulee penstock gates, believed forced out of position by hydraulic unbalance

the bottom of a gate. The bottom rib of this gate was originally $\frac{7}{8}$ in. thick but pitting has progressed to such a degree that in places the rib has been entirely removed. However, slide gates have been designed, and some of them are on order for regulating service at heads of over 100 ft.

The principal change in gate design to permit regulating service at higher heads has been a change in the bottom of the gate leaf. It now is shaped as shown in Fig. 1 (new style). The upstream face of the leaf is cut back, so that the control orifice remains at all times at the downstream edge, and there is no wide area over which negative pressures can exist. Without the oscillation of the control between the leaf edges, it is believed that these gates can be used for free discharge regulations at heads up to 200 ft or more.

The foregoing remarks apply to smaller slide gates, 6 ft by $7\frac{1}{2}$ ft or less in size. Larger slide gates in Bureau of Reclamation practice have not, up to the present, been supplied with hoisting equipment which could move the gates under unbalanced pressures. The gates are held only in the closed or fully opened positions, and the problem of damage due to cavitation does not arise.

Slide gates in simple shut-off service have almost invariably remained in use since installation and only minor repairs have been required. They may become moderately to heavily coated with rust since they are frequently so placed that their upstream faces remain inaccessible below minimum reservoir level, and the downstream faces cannot be dried sufficiently for the application of protective coatings. None, however, has as yet been found to have developed dangerous weaknesses.

Roller-Mounted Gates

In a number of installations, mounted gates of the cut-off type are placed at the intake ends of penstocks and outlets. For maintenance purposes, these gates are closed or opened only when water pressures are balanced on both sides of the gate; they are designed, however, for emergency closing with free discharge at maximum reservoir head. For such emergency closing, the bottom section of a gate must be carefully designed to avoid pressure differentials that, at critical points in the closing travel, may result in hoist loads of several times the weight of the gate.

Several types of seals, three of which are illustrated in Fig. 2, have been used on these gates. Rubber-brass seals have been used frequently and as long as these seals remain in contact with a seal seat throughout the distances of gate travel, they perform satisfactorily and have given no trouble. But the top and bottom seals on a gate are only in such contact when the gates are fully or almost fully closed. When approaching the closed position, especially at heads of 200 ft or more, these seals are sometimes forced out by unbalanced pressure to the extent of being pulled loose when squeezed against the seats.

Figure 4 shows the results of a laboratory test in which such a seal has been forced out of position by hydraulic unbalance and squeezed between gate and seat. Figure 5 shows a bottom seal on one of the Grand Coulee penstock gates, which is believed to have been damaged in like manner. Seal alterations designed to prevent such damage have been made, and some of the newer seals have been satisfactorily placed in trial service.

On wheel-mounted gates that normally remain submerged, the practice is to mount the wheels on stainless-steel pins or pins of carbon steel having nickel or stainless-steel shells which turn in graphite-insert bronze bushings. When the gates are exposed to the atmosphere for much of the time, there is a tendency for dust and grit to gather on the bearing surfaces and remove the graphite lubricant, with consequent increased friction and wear. For such gates, grease lubrication through pressure fittings is preferred.

Most slide gates, and many of the roller-and wheel-mounted gates are operated by hydraulic hoists. Hangers or latches are used to hold the gates when fully opened. Roller-and wheel-mounted gates close, once they are released, with no power other than their weight. Hydraulic hoists are normally operated under cylinder pressures of 300 to 400 psi, but are designed for 1200 to 1500 psi, emergency pressures.

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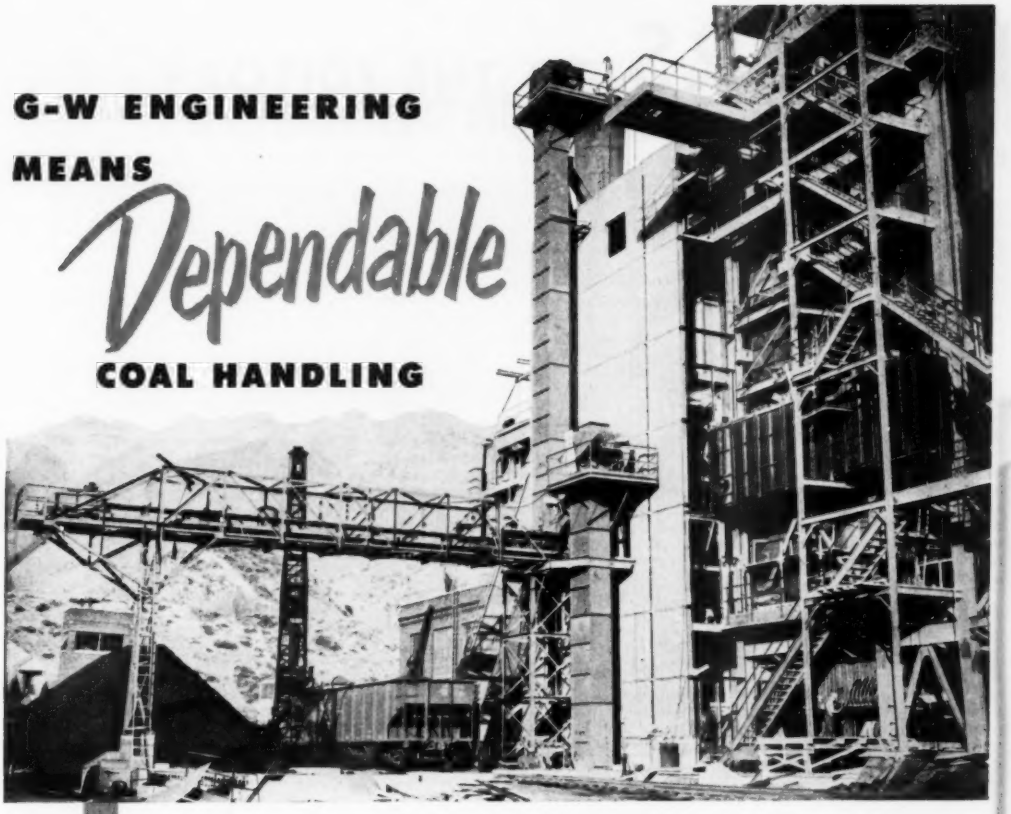

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LETTERS TO THE EDITORS

Basic Power Plant Figuring

I HAVE BEEN a reader of Power Engineering for several years and have received a great deal of assistance from it. I have found Basic Power Plant Figuring by William H. Engelman very useful. Please enter me for a copy if it is placed in book form, or will be very glad to buy a complete set of sheets covering the course being published in your magazine. I hope that this series will be issued in book form. It should be in great demand by power plant men, for it is a good refresher course for old engineers and especially useful for young engineers.

Saltville, Va. M. J. BLACKWELL

Editor's Note: — Typical of the letters we receive, this one shows that interest in Mr. Engelman's down-to-earth series continues unabated. He has more of these articles for early publication and reports progress in working up a book.

L-P Steam Line Safety

IN A RECENT answer to a question, it was suggested that the questioner use high-pressure steam to feed a low-pressure heating system, reducing the pressure by a reducing valve at the point of use. That system is all right, but if the reducing valve fails to function properly, you can get your low-pressure system filled with steam at boiler pressure, with possibly serious results.

The only good solution is to place a relief valve on the low-pressure system that is big enough to carry off, AT LOW PRESSURE, all the steam that the high-pressure side of the system can supply to it. Oftentimes that means a relief valve of considerable dimensions!

(Editor's Note: — How about using a rupture diaphragm?)

Here's a typical illustration. A lumber kiln, abandoned and badly neglected, it had been heated by exhaust from an engine. The exhaust line, bare and buried in wet earth, had rotted till completely useless. Then word came to put the kiln back in service. The heating coils were rebuilt with pipe that could be salvaged but it would hold low pressure.

The engine had been shut down, so only 200-psi boiler pressure steam was available. So a small 200-psi steam supply line was run several hundred feet, and then the steam pressure was reduced to 10 psi by a reducing valve at the kiln tunnel.

All seemed to be well till the boss went down into the narrow kiln tunnel on an inspection trip. At the reducing valve, 100 ft from the tunnel exit, he glanced at the low-pressure gage and saw that the entire low-pressure system was full of 200-psi steam! The boss put his head down and made for the exit as fast as his feet could carry him and got to the shut-off valve before anything happened.

Examination showed that the small control valve on the line leading to the reducing valve diaphragm had plugged with fine pipe scale, rendering the control inactive, and so exposing all parts of the system to steam at 200-psi.

They installed a screen ahead of the little control valve and instituted a rigid, regular inspection of the system, then installed a relief valve on the low-pressure side of the system large enough to pass all the steam the high-pressure line could bring in.

By all means use high-pressure lines to transmit steam for low-pressure work, but be sure of your safety precautions and watch them carefully.

H. B. MCDERMID

Long Beach, Calif.

Front to Back

ENCLOSED please find my answer to Question No. 479 — What Can He Do About This Hot Well Pump? — in your August issue.

As you can see, your magazine is read from front to back in the early part of the month. I believe it is one of the very best.

Your article on page 73 August, on How to Get Your Professional Engineer's License, is of much interest to many in the power field, especially those who have not had the fortune of receiving a college diploma.

Keep up your good work.

Princeton, N. J. MARVIN E. RULE

More on Smoke

YOUR AUGUST ISSUE, page 86, brought up the point: Who is responsible for smoke? In the vast majority of cases, the engineer or fireman really wants and tries to fire smokelessly. *But*, he has to use what the management provides.

Many plants in this area are old and inefficient. Loads have increased. Too often management considers the boiler room just a necessary expense and spends money on it only when compelled.

Efficient management would not tolerate antiquated, worn-out or obsolete tools in the production department; but, unfortunately, too often it does just that in the boiler room. And it does so only because it doesn't comprehend the substantial and continuous loss of cold cash represented by a smoky chimney.

It has repeatedly been shown that dense smoke is the cause of the waste of 10 per cent of the entire coal bill due to the loss of the valuable combustibles that invariably accompany the production of smoke. And when this loss is reduced to dollars and cents, it will be instantly apparent that a quite substantial change in furnace design, application of overfire air or even a change in stokers, could be financed by the savings in a few months' time. Furthermore, once those changes are accomplished, the savings continue to accrue indefinitely.

The unpleasant truth, somewhat bluntly stated, is that a smoking chimney is a finger pointed skyward, advising the world that the plant management is conspicuously inefficient and wasteful, as well as condoning a continuing threat to public health, civic beauty and the general welfare.

Chicago, Ill. JOSEPH HARRINGTON

Interest in Licenses

THE RESPONSE to my article How to Get Your Professional Engineer's License, August issue, has been very encouraging indeed. Engineers all over the country appear to be hungry for this information, as we foresaw.

The responses are still coming. Last week alone I received over 60 letters of request for information. I think POWER ENGINEERING did a fine piece of work in helping the engineering profession.

The State of Louisiana now requires a licensing examination and an engineer there wrote me saying the article was timely and wishes to work with me in helping the engineers of his acquaintance get their licenses.

The review of Refresher Notes appearing in your April issue evoked responses from as far away as West Bengal, India, Puerto Rico and the Philippines.

Thank you for your interest on behalf of the engineering profession.

JOHN D. CONSTANCE

Cliffside Park, N. J.

Bouquet

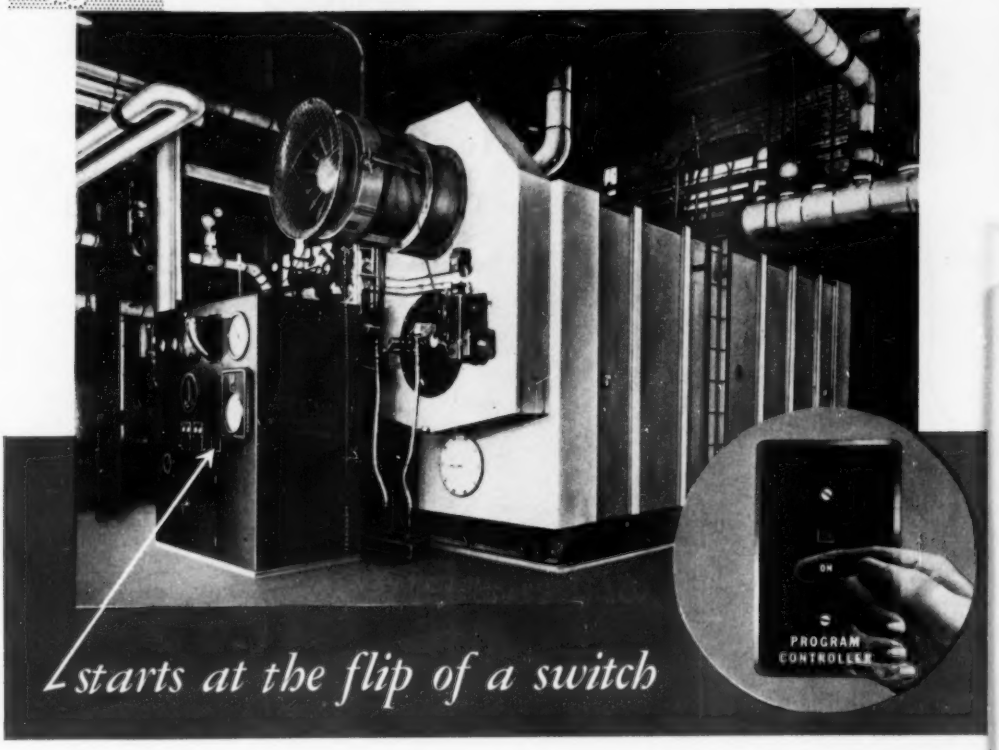
I WOULD like to commend your editorial staff for the consistently fine and informative articles that appear each month in POWER ENGINEERING. In my opinion it is the finest publication in the power field. Thanks again and best wishes for your continued success.

WERNER SPEER

East Greenbush, N. Y.

Mr. Speer is Assistant Heating and Ventilating Engineer, Division of Construction, New York State Department of Public Works.

shop-assembled Integral-furnace boiler, type FM



Automatic, efficient boiler operation with complete safety is assured by the positive dual control system offered with the B&W FM Boiler.

After the usual service operations are performed —water, fuel, and electric power turned on—a flip of a switch sets the starting program controller in operation and, in a matter of seconds, your FM Boiler is started.

Not only that! During the start-up, your FM Boiler is protected by sensitive safety devices, available with this unit, that automatically shut down your FM Boiler at the first detection of even slight malfunctioning. These electrical "policemen" act faster than an operator in case anything unusual happens—as it sometimes does with any boiler.

After your FM Boiler is started and is up to pressure, an automatic control not only provides fuel feed as required but also proportions fuel and air for best performance, all under control of safety devices.

When load conditions are so light that your FM Boiler must operate below about 25% of rated capacity—always a troublesome condition—an ON-OFF control is available to smoothly and safely start and stop the boiler automatically on the proper cycle to keep steam pressure within desired limits.

Boiler feedwater also is regulated automatically by a sensitive thermo-hydraulic control system which keeps in step with steam demand.

Full details about shop-assembled FM Boilers with steam capacities of 2900 to 28,000 lb per hr are given in Bulletin G-76. Write for it! *The Babcock & Wilcox Company, Boiler Division, 161 East 42nd St., New York 17, N. Y.*

BABCOCK & WILCOX
BOILER DIVISION

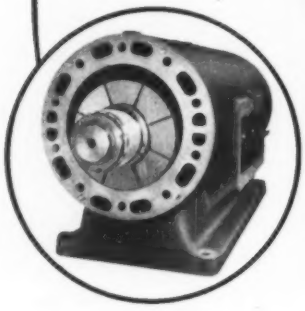
G-566

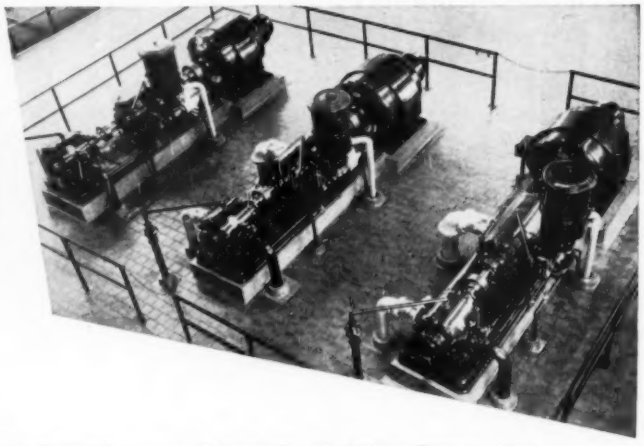
FULLER ROTARY COMPRESSORS

ELIMINATE . . .

Complicated, Moving Parts . . .

for economical operation





Fuller Rotary Compressors are designed and built to be dependable and economical in operation . . . to give a lifetime of new machine service. They have but few moving parts—rotor, bearings, and blades. That means minimum maintenance and infrequent inspection. Because blades automatically compensate for wear, *full capacity is maintained for the life of the machine.* Every detail in Fuller compressors is engineered for one purpose . . . to give you the best machine money can buy.

Thousands of Fuller Rotary Compressors are maintaining peak efficiency in plants of every size and description throughout the country. They've *earned* their reputation for complete dependability.

Fuller engineers will be glad to work with you for the proper application of Fuller compressors to your particular requirements. Bulletin C-5 gives you complete information on these quality built compressors. You'll want to study it carefully . . . see how well Fullers fit into your own plans and operations.

Fuller

DRY MATERIALS CONVEYING SYSTEMS AND COOLERS
COMPRESSORS AND VACUUM PUMPS
FEEDERS AND ASSOCIATED EQUIPMENT

FULLER COMPANY, Catasauqua, Pa.
120 So. LaSalle St., Chicago 3
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C-216

When you specify

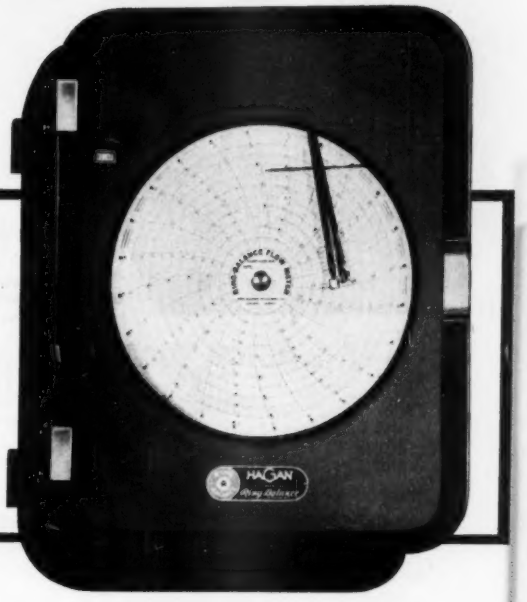
HAGAN RING BALANCE FLOW METERS

you are buying

★ **DEPENDABILITY**

★ **VERSATILITY**

★ **ACCURACY**



features of HAGAN RING BALANCE METERS include:

- **No stuffing boxes or pressure-tight bearings**
- **Excellent response at extremely low flow rates**
- **Mercury level not critical**
- **Ease of dead-weight calibration**

Hagan Ring Balance Meters are simple in design, rugged in construction. Whatever your metering problems, our engineers are at your service. For full information, get in touch with

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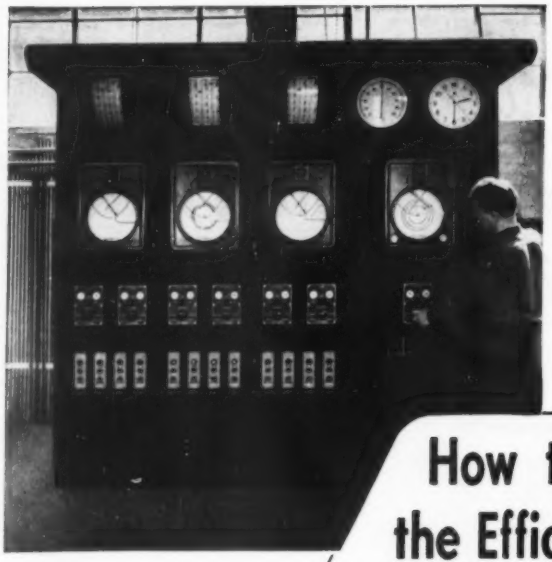
PE-10



These Bailey Boiler Controls at the Chicago Pneumatic Tool Company's new plant in Utica, N. Y. insure efficient operation of three 25,000 lb per hour, 100 psi, spreader stoker-fired boilers

How to INCREASE the Efficiency of YOUR BOILER-ROOM DOLLAR

Before you get steam you've got to spend dollars—so dollars are a form of energy.

And if your boiler-room dollars are invested in equipment that isn't working efficiently, economically, your "investment" is poor.

That's where co-ordinated controls by Bailey can help. Here's why they'll increase your "boiler-room investment efficiency":

1. **Complete Range of Equipment—fully co-ordinated.** You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. **Engineering Service—backed by experience.** No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement and automatic control.

3. **Direct Sales-Service—conveniently located near you.** Bailey Meter Company's sales-service engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

•

For better "boiler-room investment" efficiency—for more power per fuel dollar, less outage and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More power to you!"

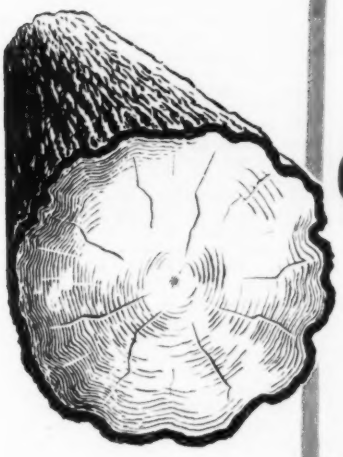
A-111-0

BAILEY METERS

BAILEY METER COMPANY

1040 IVANHOE ROAD
CLEVELAND 10, OHIO

Controls for Steam Plants
COMBUSTION · FEED WATER
TEMPERATURE · PRESSURE
LIQUID LEVEL · FEED PUMPS



How they chew 20-foot logs to chips in 12 seconds

Big 1500 hp E-M SYNCHRONOUS MOTOR *drives 6-knife chipper on back-breaking schedule*

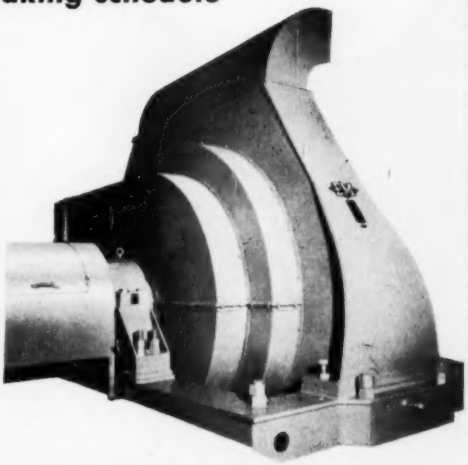
● Big logs 30" in diameter become ¾" chips at a rate of 100 feet per minute in the new Columbia Cellulose Co., Ltd. pulp mill. A 153" chipper driven by an E-M Synchronous Motor does the work.

This chipper duty is one of the roughest assignments any motor can get. The 1500 hp, 277 rpm E-M motor is specially designed for momentary output as high as 3750 hp to master the straining impacts and steady hammering of logs hitting the chipper blades.

To keep stray chips and dangerous dirt out of vital motor parts, E-M engineers specified a full enclosure. The protected Synchronous Motor is force ventilated from a screened-off fresh air source. Frame and base of heavy box-type construction and an extra large rotor are specially designed to withstand sudden shocks and strains.

Over years of strenuous chipper operation, constant torque values are maintained in the motor by E-M all-welded cage winding . . . and stout, rigid lashing of coil ends prevents distortion from starting shocks.

These are typical E-M "extras," stemming from imaginative engineering skill and long, practical experience in big motor design. Whether you want a pulp mill drive or power for another use, your nearest E-M sales engineer is a good man to know. Write the factory for *E-M Synchronizer No. 26*, a special issue for the paper industry.



THIS IS THE FULLY ENCLOSED E-M SYNCHRONOUS MOTOR driving the chipper at the new Columbia Cellulose Co., Ltd. pulp mill near Prince Rupert, British Columbia. New mill turns out 200 tons daily of high alpha cellulose.

ELECTRIC MACHINERY MFG. COMPANY
MINNEAPOLIS 13, MINNESOTA

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***Builders of the best in* BIG MOTORS**

ROTOJET®
TUBE CLEANERS

Give More Power
Use Less Air

More power with less air for a faster, more thorough tube cleaning job—that's what the new Rotojet offers. A Rotojet should save you enough in time, labor, and air on one cleanout to pay for itself. Send for Bulletin R-105 for full details.

THE SECRET

ROTOJET Motor has only two moving parts, a shaft and a paddle. Positive contact between paddle and Rotocentric (egg-shape) bore cylinder prevents stalling at low speeds. No leakage. Delivers maximum power for air used.

ELLIOTT COMPANY-ROTO DIVISION

147 Sussex Avenue, Newark 1, N. J.

GAS TURBINE

(Continued from page 65)

generator and exciter, to permit loading. This is as nearly as possible identical to a final power plant installation, except that steel fabricated columns were used to support the gas turbine instead of the ultimate concrete foundations.

The second test stand for this type of unit will have a spinning test only, thus eliminating the requirement for the loading generator with its reduction gear and direct-connected exciter. Provision is also made for full-torque, locked-rotor tests. In this second test stand, the large regenerator with its attendant hot gas ducting and pressure piping is also eliminated. Thus about 50 per cent of the production for this design will have complete load tests while the remaining units will be tested as simple-cycle units only, with free-running spin tests of the load turbine supplemented by a simulated load condition with the load shaft stationary, blocked by a specially-designed rotor locking device.

Permanent Test Equipment

To simplify testing of the gas turbines in the interest of production, the test stands include as much permanent equipment as possible. It is neither necessary nor economically sound to test equipment twice; so those parts of a complete power generating equipment which are tested at the place of manufacture and will be shipped direct to purchaser are installed as permanent testing equipment. These items include control panels, a-c generator, and exciter, main reduction gear, starting motor and assembly, heat transfer devices and piping, and all special test connections.

There is no anticipated gain in factory test operation of the lubricating, cooling water and air piping, as they must be assembled, cleaned, lined up and tested with the complete unit in the field. Therefore, this piping is also part of the permanent test stand.

Regenerators and intercoolers on the 5000-kw stand, and the regenerator on the 5000-hp stand, are permanent test equipment, as the cost of assembly and installation of these devices for the test of each unit would be prohibitive, and the assembly time required would be out of all proportion to the time required for testing the gas turbine itself.

Lubricating Systems

Lube oil tanks for the 5000-kw and locomotive test stands are installed in existing pits located some distance from the test stands. This was done to save construction time that would be required if a pit were dug alongside each foundation. A pit is necessary for these lubricating oil tanks to provide proper slope for the oil drain lines from the test stands. These permanent stands contain a steam-driven turbine pump, an a-c motor-

What's the $ Connection?

If there's a furnace operation in your setup . . . there's a mighty big connection between the CITIES SERVICE HEAT PROVER and your profit and loss picture.

Heat Prover—not an instrument you buy, but a service we supply—helps to increase furnace productivity through these five unique advantages:

1. **Rapid, continuous sampling.**
2. **Simultaneous reading of oxygen and combustibles.**
3. **Direct measurement of oxygen and combustibles.**
4. **Easy portability.**
5. **No maintenance; no re-calibration.**

ACCURATE, FAST CITIES SERVICE HEAT PROVER ANALYSIS CAN PUT THE FINGER ON WASTE IN YOUR FURNACE OPERATION. It's being widely used in a great variety of industries. Find out how Heat Prover can serve you. Write Cities Service Oil Company, Dept. J-23, Sixty Wall Tower, New York City 5.

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

GREEN FANS . . . Used by Many Leading Utilities

One significant fact about Green Fan Installations at the New Orleans Public Service Plant is that two different boiler manufacturers were involved . . . two different types of boilers but Green Draft Fans for all three boilers. Each boiler has two Green Induced Draft Fans and one Green Forced Draft Fan.

When a concern has specialized on an important piece of power plant equipment for many years, that firm is rightly called the "authority" on the subject. This is the position of Green Fuel Economizer Co. in the field of mechanical draft fans. The name Green is synonymous with Draft Fans highly acceptable to industry.

The Line of Green Induced and Forced Draft Fans includes many types in many sizes which are described in Bulletin No. 168. We shall be glad to discuss your fan requirements with your own engineers, with your consulting engineers and with the boiler manufacturer of your choice.

THE GREEN *Fuel Economizer* COMPANY INC.

BEACON 3, NEW YORK

ECONOMIZERS • FANS • AIR HEATERS • CINDERTRAPS

driven pump and a d-c motor-driven emergency pump. All three pumps are run constantly, with an alarm system provided to indicate loss of pressure from any pump.

Due to the elevated construction of the 5000-hp test stands, it is possible to install the lube oil tanks in the same location they will occupy in a field installation. The pumps on these tanks include a primary mechanical shaft-driven pump, operated from the gas turbine accessory drive unit, an auxiliary a-c motor-driven pump and an emergency d-c motor-driven pump. These latter two pumps are controlled by pressure switches in the lube lines.

The d-c motor-driven emergency lube oil pumps protect against loss of shop a-c power. A battery back-up system is also provided to operate automatically in case of loss of shop d-c power.

Each lubrication system contains both cartridge and magnetic type filters to assure all possible protection against damage to bearings. The magnetic filters are used particularly to remove chips and welding spatter, which may be present due to the frequent openings of the lube oil system as units are assembled for and are removed from test. In addition, the oil is periodically removed from the unit oil tanks and centrifuged.

Fuel System

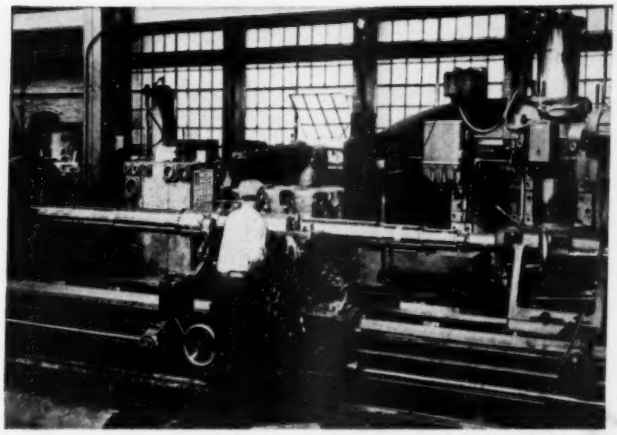
Although gas turbines may be run in field installations with either natural gas or petroleum fuel, all factory testing is done with a distillate. This common fuel system has been chosen in order to simplify the storage, pumping, filtering and necessary distribution equipment. Neither natural nor artificial gas is available in sufficient quantity at the manufacturer's plant to permit testing on gas.

Fuel oil is stored in several underground tanks outside the building. These tanks are connected through a transfer house so that oil from any tank can be piped to any of the four production test stands. These tanks are maintained at constant temperature for more accurate measurement of flow. The oil lines to the test stands contain specially calibrated meters for determining fuel rates of the turbines.

Loading Equipment

Three of the four stands have geared a-c generators so that performance data over the complete load range can be obtained on the gas turbines. Two large water boxes enable load tests to be run on two units at the same time. One of the water boxes is the standard large wood-stave barrel type with three moveable electrodes. The other is a newly-designed, three-leg, closed-cooling-circuit unit. Controls for both water boxes and facilities for measuring generator output are provided on a permanent load control station, Fig. 9, located at each test stand. It is

When you need a tough, fatigue- and corrosion-resisting alloy —try "K" Monel



This is the largest INCO Nickel Alloy pump shaft in the world. The shaft is 13 feet 7⅛ inches long, 9.005 inches at its widest diameter, and weighs 3,343 lbs. It was forged by INCO'S Huntington Mill from "K" Monel for Consolidated Edison Co., after other materials repeatedly failed. Neither "K" Monel nor Monel have ever been known to fail from corrosion fatigue in salt water.

Are there applications in your operation where metal is subject to fatigue, corrosion and erosion?

Then chances are "K" Monel is the alloy you need.

"K" Monel is a tough, corrosion-resisting wrought alloy of Nickel, copper and aluminum. It offers you the excellent corrosion resistance of regular Monel, together with the added advantages of greater stiffness and hardness through heat treating.

As evidence of the value of "K" Monel's added advantages, take a pump shaft operating in highly corrosive and polluted salt water.

New York City's Consolidated Edison Company has two big 80,000-gallon-per-minute condenser circulating water pumps. For years engineers kept replacing the shafts with materials of increasing strength but failures would continue to occur in the same spot because of corrosion fatigue.

Finally, they decided to try "K" Monel.

A 1½-ton heat-treated "K" Monel shaft with a tensile strength of 140,000 pounds per square inch was installed in September of 1949 and has been functioning perfectly ever since. In fact, the pump casing has not even been opened for inspection since installation.

Let's take a quick look at a few of the principal characteristics of "K" Monel:

Age-hardenable, or capable of having its hardness and mechanical properties increased simultaneously as the result of thermal treatment, "K" Monel is equal in strength and toughness to many heat-treated alloy steels. It shows improved strength and hardness at sub-zero temperatures with no loss of toughness. And it provides moderate strength at temperatures up to 900° F.

"K" Monel is non-magnetic under ordinary conditions, and remains so down to −150° F.

The working characteristics of "K" Monel are excellent, too. It is readily machined in an annealed condition, but in other conditions may be considered commercially machinable at practical (although generally somewhat slower) rates. It can be joined by the usual welding, brazing and soldering processes.

You'll find all essential engineering data on "K" Monel and its more machinable companion alloy, "KR" Monel, in the 24-page reference manual, "Engineering Properties of 'K' Monel and 'KR' Monel." Write for your copy.

One last—and important—point. "K" Monel, like other INCO Nickel Alloys, is now on extended delivery because of defense needs. So it is important to include NPA rating and complete end-use information with all orders.

The International Nickel Company, Inc.

67 Wall Street, New York 5, N. Y.

Nickel INCO TRADE MARK Alloys

MONEL® • "R"® MONEL • "K"® MONEL "KR"® MONEL • "S"® MONEL • NICKEL • LOW CARBON NICKEL • DURANICKEL® • INCONEL® INCONEL "X"® • INCOLOY • NIMONICS®

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PRESSURE Seals It!

• This R-P&C Valve has an inside bonnet which is forced tightly against a special metal sealing ring by the pressure in the valve. It stays tight under conditions of varying pressure, and the compensating wedge makes it easy to open and close. Also made as a globe valve.

Designed for high pressure, high temperature service. Cast steel construction. Sizes from 2½" to 12"; pressures to 1500 lbs.; temperatures to 1100° F.

For further information, see your R-P&C distributor or write the nearest R-P&C district office.

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R-P&C valves

unfortunately not possible to absorb this test power in the local a-c power system, since the loading schedule may not fit the system operation schedule, and the sudden addition or loss of 5000 kw of power, more or less, would be very difficult for the system dispatchers to handle without inconvenience to other power users.

Special Instrumentation

The more than 100 temperature readings picked up by permanent thermocouples at various locations are recorded on a single high-speed recorder. Each thermocouple is connected through a switching arrangement so that the reading can be transferred to an indicating meter. This system was instituted so that quick spot checks could be made on individual thermocouples. The recorder is of the type that provides for automatically printing each temperature in rotation and for recycling any group of twelve readings. This enables all readings to be taken when running performance points, or for special groups such as bearing or exhaust temperatures when undergoing transient conditions.

Pressures are taken by means of standard gages, water manometers, mercury manometers, Fig. 12, inclined draft gages and special precision gages.

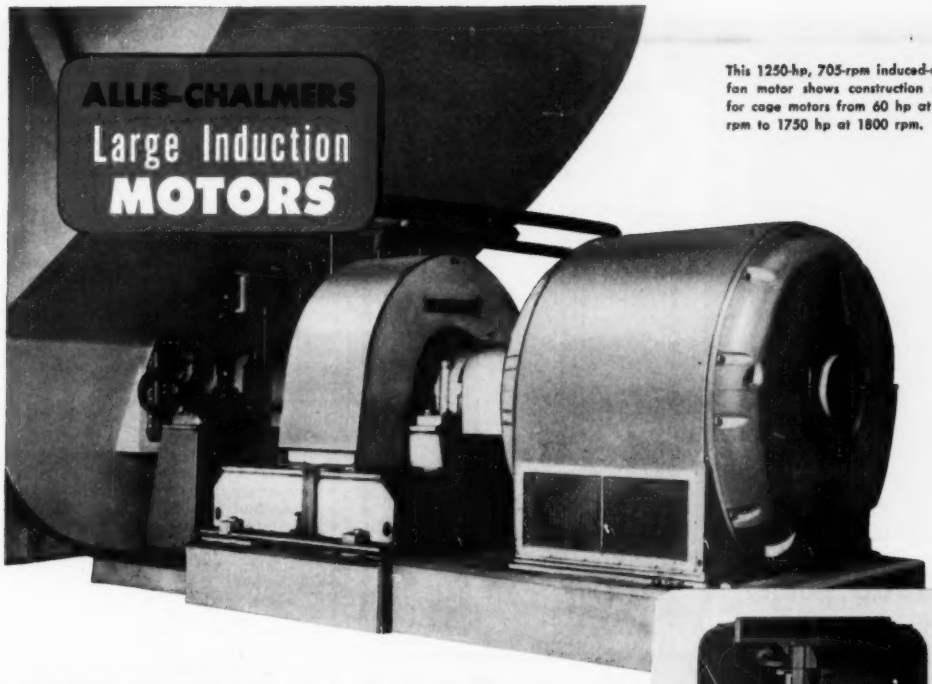
Personnel

Testing of the gas turbines is conducted by the product test section. The majority of the men in this group are technical graduates who are on the company's Test Engineer Training Program. The test section is under the direction of a Head of Test and individual shift heads. Under the shift heads, who normally have a one-year assignment, are "sign-ups" who are on six-month assignments. These sign-ups are in charge of a group of Test Engineers on three-month assignments and handle actual operation of the units.

A running force large enough to operate two units is maintained at all times. This requires shifting men from one type of unit to another about once a week, and to other short tests such as the lube tank test and unit assembly tests. No difficulty has been encountered by moving the men around, as operation of all units is similar.

The test group is entirely responsible for checking, starting, operating and taking data on all machines. Operation is on a three-shift basis and tests lap over shifts without interruption or loss of time.

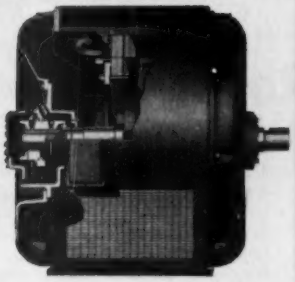
A regular series of bi-weekly lectures is conducted to acquaint test personnel with division organization and all phases of gas turbine engineering and manufacture. These lectures are given by key men in the various sections and not only provide the men with valuable information on operation of the units, but give them an opportunity to determine if they are interested in seeking later posi-



This 1250-hp, 705-rpm induced-draft fan motor shows construction used for cage motors from 60 hp at 300 rpm to 1750 hp at 1800 rpm.

GOOD TO LOOK AT...
and Worth Looking Into

THIS MODERN Allis-Chalmers cage motor looks good in modern power plants—one glance at its clean, simple lines and smooth contours tells you that. But only a careful check of its design features can show how much it offers in all-around protection, easy accessibility, and operating dependability.



Cutaway view indicates construction features of this modern motor. For details, ask your A-C representative for Bulletin 05B7542, or write to Allis-Chalmers, Milwaukee 1, Wisconsin.

Protection begins with drip-proof construction as standard above 500 rpm. (Splash-proofing entails no change in external appearance.) In addition, louvers on air discharges and design of intakes keep foreign objects out of the motor.

Accessibility starts paying dividends during installation; large stator air discharge openings allow ample room for drilling, doweling and bolting. And they encourage cleaning of air passages back of the stator core. For cleaning or inspecting the windings, only the upper halves of the end shields need be removed — there's no need to disturb the bearings.

Dependability stems from rigid cast-iron end shields that assure maintenance of correct bearing alignment. Capsule-type bearing housings protect the bearings and oil supply while the motor is being cleaned. And other construction details further uphold the reputation for long-life reliability enjoyed by Allis-Chalmers motors. A-3828

ALLIS-CHALMERS

tions in gas turbine engineering, sales, service or manufacturing groups after completion of their test program assignments.

Several special training programs also have been held at the factory to enable purchaser's and company installation personnel to become acquainted with the new equipment.

Summary

These testing facilities have been provided to ensure complete and accurate testing of all gas turbines and components before shipment to purchaser, thus reducing the shakedown period for testing and adjustments on purchaser's foundations. As more experience is gained, changes will continually be made in both equipment and procedures in order to take advantage of all possible improvements.

Since three of the four permanent stands are essentially identical to purchaser's ultimate installation, with the exception of the building and grounds and local improvements, it is apparent that the manufacturer is forced to an investment for testing facilities for each type of gas turbine cycle equivalent to the purchaser's investment in his permanent installation. This investment is, of course, in addition to the investment in manufacturing plants, machine tools and facilities required for the production of the gas turbines. It is expected, however, that this large investment will more than pay off in the long run by permitting rapid mounting and testing of the gas turbines, and delivery to the Shipping Department, in a minimum time after they are received from the assembly floor.

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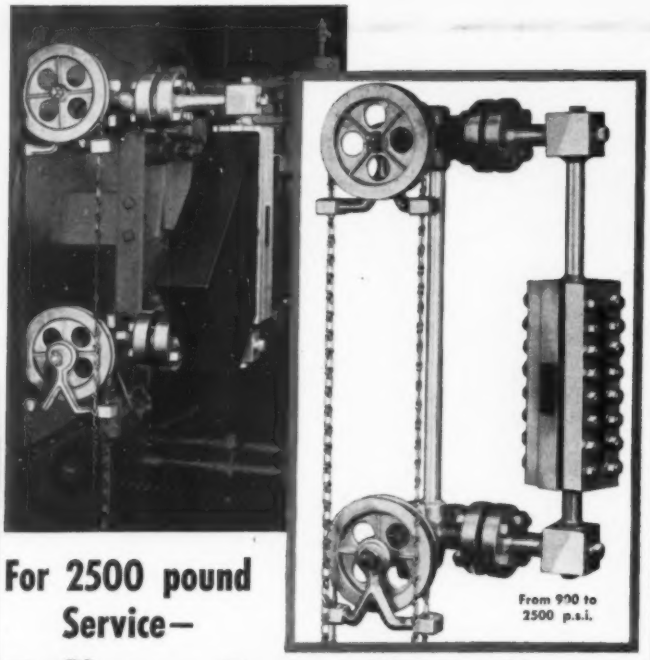
STRYKER DIESEL

(Continued from page 67)

Clean air for the engine is secured by passing air through a roof-top filter. Starting air is supplied by a motor-driven compressor, with a gasoline-engine-driven unit for emergency stand-by.

Four engine control panels comprise the plant's switchboard. One panel is used for each of two city circuits and one for street lighting. Fourth panel holds a synchronizer, a-c and d-c voltmeters and a frequency meter. One voltage regulator serves the smaller engines while a



For 2500 pound Service—

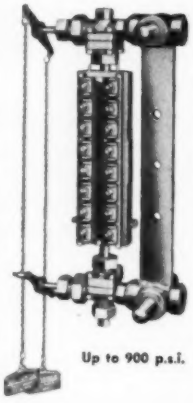
Reliance Super-Duty Gages

Rugged all-welded direct-to-drum assemblies

Various combinations of Reliance Gage Valves, Gage Inserts and Illumination have been supplied to power plants *since 1940* when Code changes called for two water gages on boilers operating over 400 p.s.i. Assemblies for higher pressures feature single, double or triple window inserts welded to flanges for valve connection in "L" end construction. Units for pressures to 900 p.s.i. can be made in tie-bar construction.

Reliance Micasight insert is recommended for higher pressures as by far the safest type known. Windows of selected mica are clamped securely under slotted cover plates — have many times the life of glass. Mica-protected Flat Glass inserts are available for lower pressures, recommended only to 1500 p.s.i. Efficient illumination, an extra, can be supplied for all types of gage assemblies.

Send specifications — pressure, visibility length, etc. — for recommendations and price.



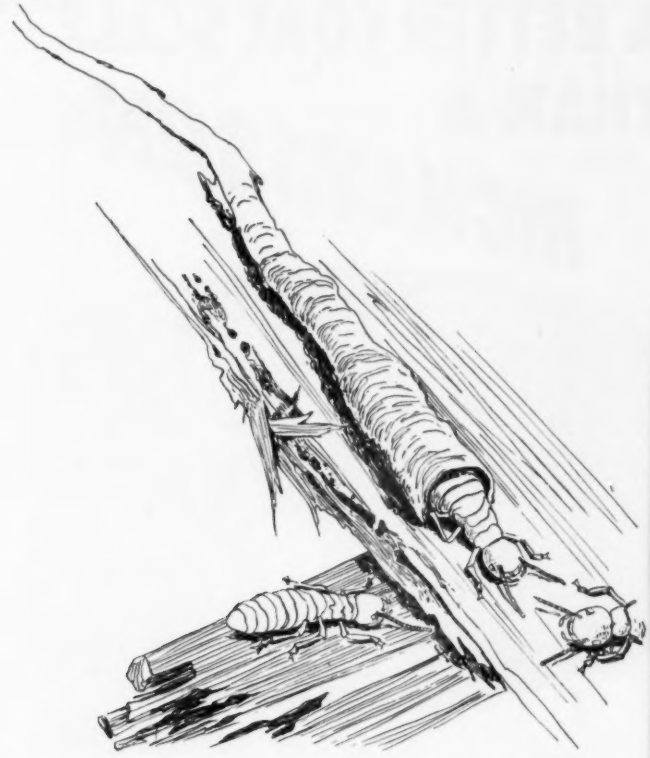
The Reliance Gauge Column Co.
5902 CARNEGIE AVENUE • CLEVELAND 3, OHIO

The name that introduced safety water columns.... in 1884

Reliance®

BOILER SAFETY DEVICES

tubing...



Blind from birth, termites, the industrious scavengers of the forests, often build their own peculiar tubing in order to reach a wooden structure.

Pipe and Tubular Products fabricates tubing, too, but for vastly different purposes: condenser tubes, boiler tubes, tubing for superheaters as well as welded tubing and structural fabrication. And our new, larger plant at Catasauqua, Pa., means greater variety of service to our customers, widens horizons for our clients.

Our facilities for the fabrication and bending of piping and tubing are bigger than ever before—50,000 square feet. With these added facilities, we've been shipping more orders in less time . . . orders for tubing for many things from bicycle frames to bus exhausts, tubular parts for trucks and tractors, motors and machinery, frames and fuel lines . . . the list is long and varied. We bend all kinds of tubes to different shapes for many purposes.

Service, however, remains paramount with us. An extremely large warehouse stock of resistance-welded and seamless tubing from ½″ to 5″ OD means no waiting for mill delivery. On emergency repair jobs, shipments are made the same day the order is received.

Why not take advantage today of highly-skilled workers, a specialized experience of many years in this field, and extra-fast delivery by a big fleet of trucks? Unlike the termites, we have our eyes wide open . . . especially when it comes to fast, dependable service.

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Silverstat regulator serves the 695-hp engine.

Since installation the new engine has not caused one service interruption, and has given efficient performance with negligible maintenance costs.

Annual Report of Power Plant and Distribution System, Stryker, O. 1951

Total generation, kwh	1,414,810
Plant use, kwh	39,846
Plant sendout, kwh	1,374,964
Street lights, pumping city water, park and city building, kwh	134,139
Power sold or metered on line, kwh	1,250,836
Distribution loss, per cent	9.1
Load factor, per cent	43.5
Fuel oil consumed, gal	118,624
Kwh per gal fuel oil	11.92
Fuel oil costs	$12,692.76
Labor and retirement	$10,871.36
Labor on line	$2,109.15
Material	$1,911.96
Supplies and repairs	$1,277.67
Lube oil cost	$790.88
Collecting bills	$785.53
Insurance and salaries	$751.37
Truck charge	$99.96
Truck material and gas	$78.80
Cards	$50.43

Principal Equipment at Stryker

Diesel Engine, National Supply Co., Engine Div.
Supercharger, Elliott Co.
Generator, Ideal Electric Co.
Exciter, Ideal Electric Co.
Switchboard, General Electric Co.
Governor, Woodward Governor Co.
Air Filter and Silencer, intake, Air-Maze Corp.
Silencer, exhaust, Maxim Silencer Co.
Voltage Regulator, Westinghouse Electric Co.
Injection Pumps, Bendix Aviation Corp., Scintilla Magneto Div.
Lubricating Oil Filters, The Hilliard Corp.
Fuel Oil Filters, Purolator Products, Inc.
Heat Exchangers, Marlo Coil Co.
Lubricating Oil Cooler, Ross Heater and Mfg. Co.
Alarms, The National Supply Co.
Jacket Water Circulating Pumps, Ingersoll Rand Co.
Fuel Transfer Pumps, George D. Roper Co.

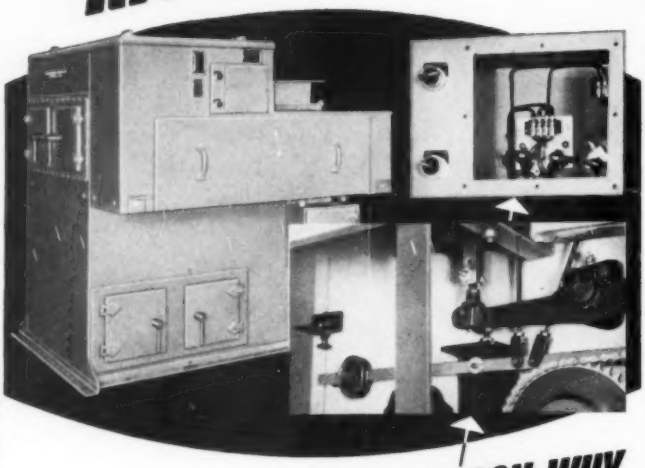
WASTE HEAT CAN MAKE VALUABLE STEAM

(*Continued from page 95*)

and high or moderate gas temperatures. Extended surface may be used under suitable temperature conditions with clean gases. Circulation is good, but, of course, heat absorption rates are limited. A superheater and an economizer are readily adapted and auxiliary firing may be provided. Gas flow may be parallel to drums or perpendicular to them. By suitable baffle arrangement, the flow may be made parallel to the tubes.

If the gas is dust-laden, two lower drums are used with dust hoppers located between them. The unit is usually supported at the upper drum with the lower drum suspended by the tubes, permitting free expansion. The steam drum should be of ample proportion to provide steam release. Tubes should all be well submerged at the upper drum and fully drainable to the lower drum. Tube size and arrangement at the drums affect ligament efficiency and drum cost.

YOU CAN'T BUY A BETTER COAL SCALE THAN A RICHARDSON



..AND HERE'S ANOTHER REASON WHY..

WIRING AND CONTROLS OUTSIDE COAL CHAMBER

All electrical wiring and controls are outside the coal chamber. The sulphuric-acid-laden air and dust of the coal chamber can never harm a Richardson Coal Scale because of this fact. In all ways—in all aspects of design and construction—sound, foresighted, time-proved Richardson engineering is your assurance that the dependability, accuracy, and ruggedness built into the Richardson Scale will be maintained for the life of the unit. Richardson inspection and service are available nationwide.

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Move in STEAM *to order*

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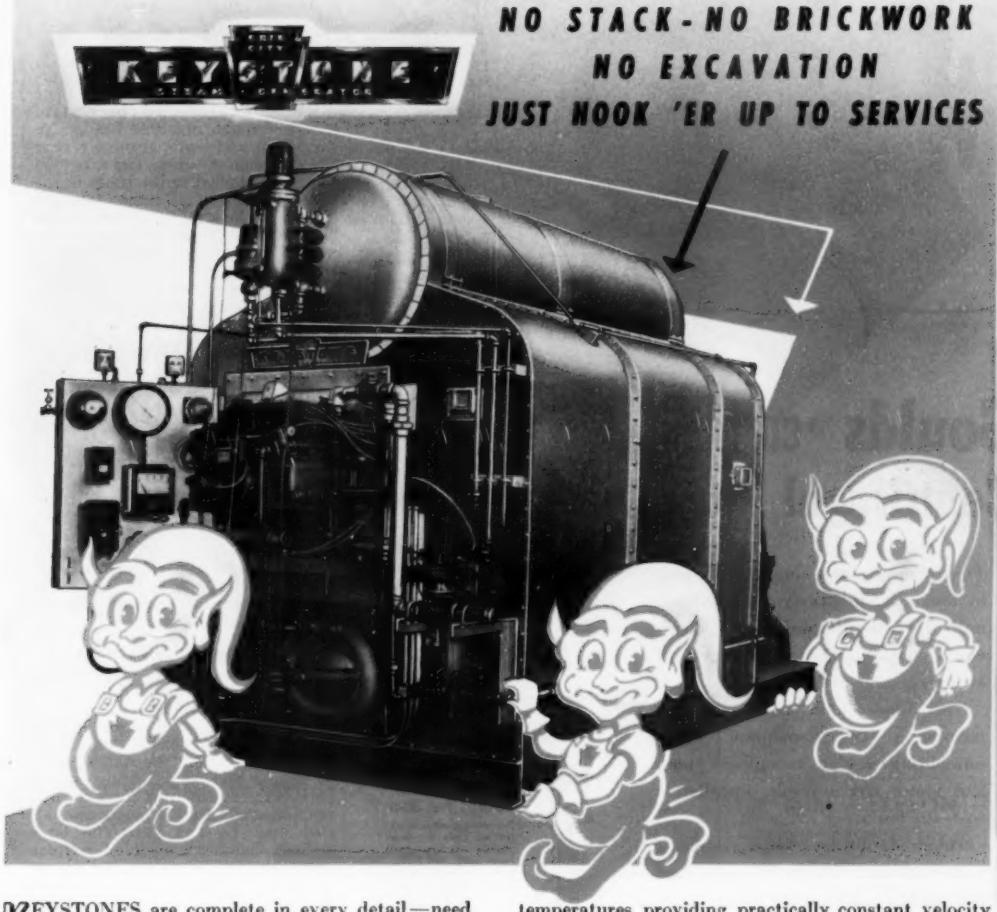
NO EXCAVATION
JUST HOOK 'ER UP TO SERVICES



KEYSTONES are complete in every detail—need only to be connected to services. Keystones are compact, 2-drum *water tube* boilers designed for high capacity operations in a wide range of operating pressures. They are conservatively rated (5 square feet of heating surface per developed h.p.)

They feature cyclonic center firing with oil or gas or both. Gases travel 3 complete lengths of the boiler and gas areas are carefully proportioned to decreasing temperatures providing practically constant velocity and assure *no pockets where unburned gases can accumulate.* All boiler surfaces exposed to heat transfer are completely submerged below water line.

You can install a Keystone indoors or outdoors close to steam application. It's fully automatic and requires only part time operator. Booklet SB-38T is available.

You can depend on Erie City for sound engineering

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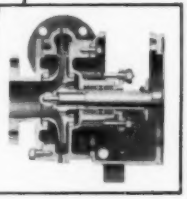
113 Years in Steam Generation

ERIE CITY IRON WORKS • *Erie, Pa.*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS • PULVERIZERS

Where Space is a Problem...

GOULDS Fig. 3650
Full open top construction permits ready access to gland and stuffing box—particularly desirable when pump is not in a readily accessible position.



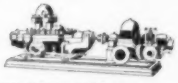
Goulds "Close-Cupld" Centrifugal Pump is the Answer

This versatile pump, simple and sturdy in design, is an entirely self-contained unit. Its close-coupled design eliminates coupling and assures perfect alignment with freedom from vibration.

The "Close-Cupld" needs no space-consuming special foundation . . . no unwieldy base plate to support pump and motor. As a result, installation costs are low.

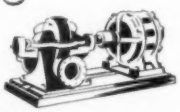
Hundreds of these pumps are doing a wide variety of jobs in factories, steel mills and chemical plants. Interchangeable parts keep inventories low. Available in a wide variety of sizes. Capacities to 2000 G.P.M. Heads to 400 ft. Bulletin 710.1 gives complete specifications. Send for it today. Or call your Goulds representative for the full story.

Other GOULDS Widely Used Throughout Industry



GOULDS Fig. 3360—High pressure multistage centrifugal. Full range of capacities and pressures. Bulletin 722.5.

GOULDS Fig. 3047
Nonclogging impeller of this vertical sump pump will handle water containing solids or fibrous materials.



GOULDS Fig. 3450—Double-suction, single-stage Goulds centrifugals. Up to 15,000 G.P.M. Heads up to 500 ft. Bulletin 721.2.

MEMBER

Goulds PUMPS INC.
Seneca Falls
New York

Refractory or steel lined casings are used as temperatures indicate. Outer casings must be fully insulated from the inner linings and sufficient cleanout doors provided. Side casings are removed for the tube replacement and tubes are arranged so that individual tubes may be replaced.

Extended Surface

Another water-tube type, Fig. 2, employs extended surface and is arranged with horizontal hairpin bent tubes, series-connected in parallel groups through manifold headers to the steam and water drum by riser and downcomer tubes. The extended surface is applied to the tubes in the form of cast iron gill rings thermally shrunk on the steel tubes. The design was developed for application to contact sulfuric acid plants. The gases are under moderate pressure and contain considerable SO_2, hence the cylindrical shell of leakproof arrangement with horizontal tubes.

Hairpin Tubes

The hairpin tube arrangement provides for thermal expansion and means for removal of tubes without having to pass the extended surface rings through a tube sheet. Great care must be taken in this arrangement to be sure that adequate circulation is provided. The drum is arranged to prevent reverse circulation, promote thorough separation of steam, as well as complete mixing of feedwater, water treatment chemicals, and the concentrated water from the risers before these enter the downcomers.

Reverberatory Furnace

Special arrangement of a water-tube waste heat boiler, Fig. 4, is applied to a reverberatory furnace in a copper smelting process. In this instance, the gas comes from a large furnace containing the molten mass of copper and slag. During certain periods in the smelting process, molten slag and metal droplets are carried over by the gas. The large radiant chamber is designed to freeze the liquid droplets in suspension and to lower gas velocities so the solidified particles fall out of suspension into the hoppers provided. Gases enter the radiant chamber at about 2200 F and the convection bank at about 1400 F, passing first through a slag screen of tubes.

Catalyst Cooler

Of special interest are the catalyst coolers, Fig. 6. In the catalytic reaction a carbonaceous by-product is deposited on the catalyst. This coke is burned with air in the regenerator. The regenerated catalyst is made to flow with carrier air upward through the tubes of the coolers, which are fire-tube type waste heat boilers. The external steam drums are elevated to provide the thermosyphon head for natural circulation. Two identical coolers are arranged for parallel operation.

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In the widely diversified line of Raybestos-Manhattan packings and gaskets, you will find products specially made to solve your toughest packing problems. Let your nearby R/M distributor help you specify the packings that will assure you of long trouble-free operation. Give him a call today.

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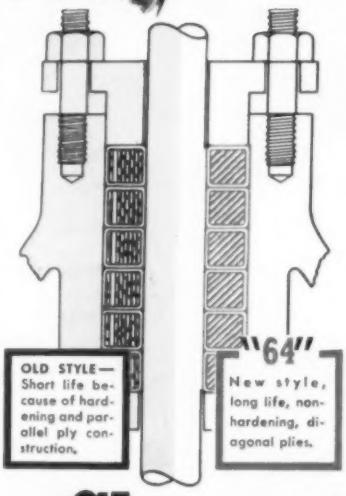
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Short life because of hardening and parallel ply construction.
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New style, long life, non-hardening, diagonal plies.

Long service against steam demands a packing of resilient construction and non-hardening materials. In Chesterton "64", the resilient asbestos diagonal plies adjust themselves, pressurewise, snugly against the rod; the exclusive binder resists hardening even under superheat. Try Chesterton "64" and you will find it's a long, *long* time, often years, before repacking. Send coupon for free sample.

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GENERATOR EXCITATION

(Continued from page 93)

cent to the new value in 0.72 sec. Absence of overshoot illustrates the excellent stability of the system.

Increasingly important requisite for generator voltage regulating systems is the ability of the system to aid in preventing "pull-out" or loss of synchronism of the generator with respect to the a-c system. The underexcitation limit used with modern regulators maintains sufficient generator field current to prevent pull-out under various generator loads. This feature is particularly important with present-day designs of machines when operation is in the underexcited or leading power-factor region. The underexcitation limit of the regulating system is a new device operating on a new principle and provides a high degree of flexibility in adjustment to meet special requirements. A typical setting for the underexcitation limit for a turbine generator is shown in Fig. 5, where the limit is coordinated with the generator capability curve.

Obituaries

WILLIAM HENRY REA

William Henry Rea, chairman of the board of the Detroit Stoker Co., died on July 2, 1952, at Henry Ford Hospital. He was 86 years old. Mr. Rea had been associated with Detroit Stoker Company for nearly 50 years, most of the time as President until his recent election as chairman of the board.

He was a past president of the Stoker Manufacturers Association, and for many years was active in the affairs of the American Boiler Manufacturers Association and affiliated industries.

He was born in 1865 and had his first job at the age of 13 with the old saddlery and harness-making firm of Armstrong and Graham. By 1906, after 25 years of service with that firm, he had become its

sales manager but realized that the age of the horse was disappearing and turned to the field of engineering.

Mr. Rea was active in civic and philanthropic organizations in Detroit, being a supporter of the original Detroit Symphony Society and a member of the Detroit Art Founders and Detroit Historical Societies, as well as a member of the Detroit Athletic Club and other clubs.

CECIL C. WILLIS

CECIL C. WILLIS, Superintendent of Generation for Oklahoma Gas and Electric Co. for the past 11 years, died June 27 at Oklahoma City from a heart ailment. He was 53 years old.

Mr. Willis had been with OG & E for 30 years. He received a degree of Mechanical Engineering from Kansas University in 1922. He was a member of American Institute of Electrical Engineers.

FRED C. HANKER

FRED C. HANKER, 71, Westinghouse engineer, passed away Saturday, July 26th, at Stanford, California. He had continuous service with Westinghouse since 1903 until he retired in 1935.

Mr. Hanker was manager of central station engineering for Westinghouse at East Pittsburgh prior to his retirement, and was hailed in the 1950 mid-century edition of the *Westinghouse Engineer* as having played an outstanding part in the growth of the electrical industry. Particularly notable was his leadership in the development of electrical utilities distribution systems and power transmission. Mr. Hanker has been making his home on the Stanford University campus where he lectured after retirement.

THOMAS CRUTHERS

THOMAS CRUTHERS, Vice President of Worthington Corporation since 1936, passed on at his West Orange, N. J. home on Sunday, July 27th.

Mr. Cruthers, who graduated from Stevens Institute of Technology, joined the Worthington organization in 1907 in charge of the Gas Engine Field Erection Department. From 1925 to 1929 he held successive positions of sales engineer, assistant sales manager and sales manager in the New York office. From 1930 to 1932 he was assistant general sales manager and from 1932 to 1936 assistant vice president in the general sales department.

He was a member of the board of governors of the National Electrical Manufacturers Association, a director of the N. J. State Chamber of Commerce, and a member of the Society of Naval Architects and Marine Engineers, American Society of Refrigeration Engineers, National Association of Manufacturers and the Heat Exchange Institute.

He was also a member of the N. Y. Railroad Club, the Traffic Club of New York, Montclair Golf Club and the Essex Club of Newark.

Chesterton

PLASTIC PACKING 550 stands up to:

ASPHALT
BUTANE
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Distillates

Here is a modern packing, so tough that it stands up under severe conditions; so "plastic" that hand or gland pressure squares it up to the required stuffing box size. Chesterton 550 Plastic Packing is an extruded compound of special long-fiber asbestos, high grade lubricants and anti-frictional, non-scoring components that are not subject to flux up to approximately 1000°F. Ideal for use on centrifugal and rotary pumps. Your local Industrial Jobber stocks 550. Order from him today.

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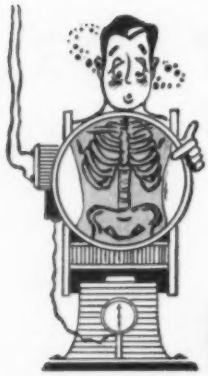

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FLOW SIGHTS

Bowser Flow Sights let you "see all"—enable you to keep a watchful eye on your liquid handling operation. It pays to know just what's going through your lines. Available in either single or double window, gravity or pressure models, Bowser Flow Sights are made in various metals for a variety of liquids.

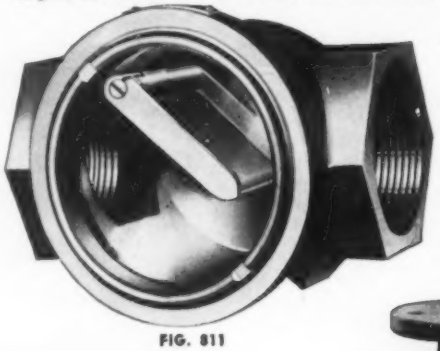

FIG. 811

This vane-type Bowser Indicator is spring-actuated, thus providing an indication of the quantity flowing in the line.

FIG. 811

FIG. 54A

This Bowser Flow Sight is recommended for use on gravity lines where the flow is vertically downward.

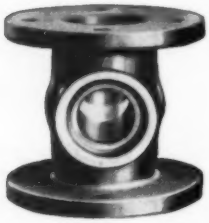

FIG. 54A

FIG. 816

FIG. 816

The Figure 816 Bowser Teleflo Indicator is equipped to operate a gong or to stop pump motor if liquid flow stops.

Consult with the Bowser engineer nearest you.

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New ENGINEERING BOOKS

Cooling Towers, by J. Jackson, B.Sc.; 104 pages; size 5½ by 9½ in.; cloth binding; published by Butterworth's Scientific Publications, Bell Yard, Temple Bar, London, W.C. 2, copies available from Butterworth & Co. Ltd., 1367 Danforth Avenue, Toronto 6, Ontario, Canada; price $3.50.

This handbook is the result of systematic research and practical experience at the plants of Imperial Chemical Industries Ltd., and has been designed to assist the non-specialist and student of chemical engineering to understand water-cooling towers of the mechanical-draft type which are found in British and European industrial plants of many kinds.

It sets forth clearly and concisely how cooling towers can be designed, tested, and the test data interpreted. It describes a rational method of design for a particular type of tower, believed to be an improvement on the other types at present available. The methods used for the design of this particular type may serve as a model for the design of other types of tower, and apparatus of a similar character.

★ ★ ★

Engineers 'Illustrated Thesaurus, by Herbert Herkimer; 1st edition; 572 pages; size 5½ by 8 in.; cloth binding; published by Chemical Publishing Co., 212 Fifth Ave., New York, N. Y.; price $6.00.

Over 8000 illustrations of machine elements and assembled machinery are included for the engineer, designer, draftsman and manufacturer which will help them select the machine parts or the equipment most suitable for their special purpose. It will also serve as an efficient guide for students and beginners.

Every conceivable type of machine element is clearly reproduced and identified. Where necessary an explanation of the method by which it accomplishes its particular function is given. For additional convenience there is an exhaustive index to save much page-thumbing.

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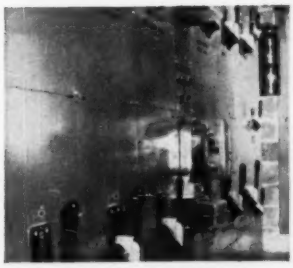
Once you have seen this book you will wonder how you ever got along without it before.

REVERE COPPER
IN TWO GREAT SEATTLE PROJECTS

Northgate Project, suburban shopping center, seen from the air

Air view of University of Washington's Health Sciences Building

Switch and fuse type lighting panelboard for control and protection of lighting circuits in another Northgate store



Main switchboard in a Northgate store

Large electrical loads are required to serve these two Seattle projects. To carry heavy currents safely and with minimum voltage loss, prefabricated Flex-A-Power distribution systems, with copper bus bars made by Revere, were installed, plus protective circuit breaker switchboards, control centers and lighting panelboards. Revere Copper, Brass and Bronze are used in these products. Flexible distribution systems and protective control equipment were furnished by Trumbull Electric, Department of General Electric Company, Plainville, Connecticut, and Seattle, Washington.

The two projects consist of the University of Washington's Health Sciences Building, dedicated in 1949, housing the schools of medicine, dentistry, and nursing; and the Northgate Project, world's largest shopping center, containing 78 stores plus 50 medical offices, a hospital, a theater, covering 26 city blocks. In the generation and use of electricity copper is preferred, because it has the highest electrical conductivity of all the commercial metals. Revere is proud to have supplied copper for these two large projects, and to many others the country over.

Electrical distribution runs fan out from four dead-front, self-contained load centers located in Health Sciences Building basement

Four-wire, 2000 amp Trumbull Flex-A-Power system distributes power throughout new Health Sciences Building

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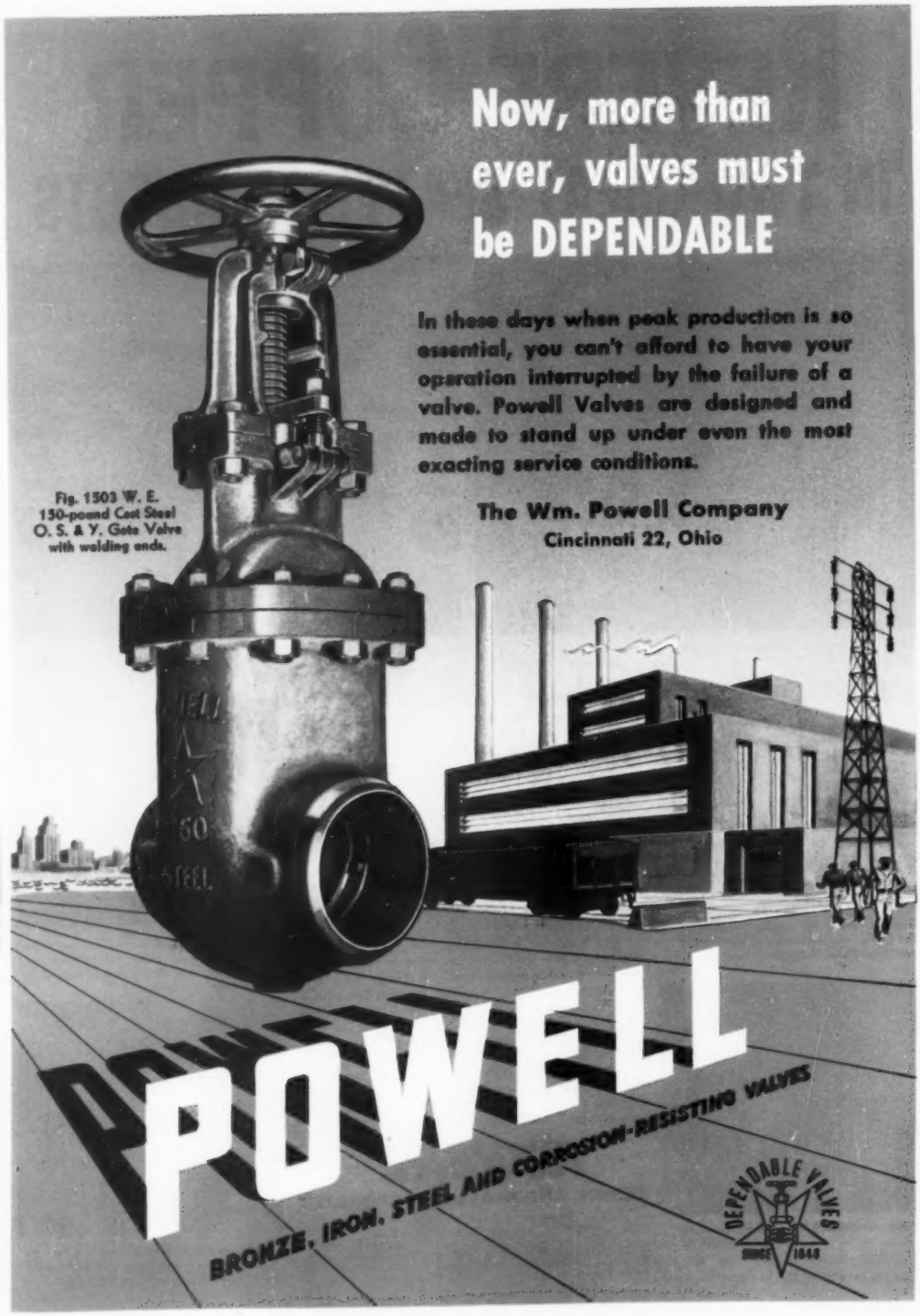
Now, more than ever, valves must be DEPENDABLE
In these days when peak production is so essential, you can't afford to have your operation interrupted by the failure of a valve. Powell Valves are designed and made to stand up under even the most exacting service conditions.
The Wm. Powell Company
Cincinnati 22, Ohio
Fig. 1503 W. E. 150-pound Cast Steel O. S. & Y. Gate Valve with welding ends.
POWELL
BRONZE, IRON, STEEL AND CORROSION-RESISTING VALVES
DEPENDABLE VALVES
SINCE 1846

HELPFUL BULLETINS

(Continued from page 82)

instructions included for each group. Standard couplings are shown in individual sections and followed by a section of special couplings. A wide range of horsepower and speeds covered. Book is available to qualified power engineers, please state title when requesting this catalog. Thomas Flexible Coupling Co.

PUMPS AND COMPRESSORS

137 Wet Pit Pumps — Bulletin 3-2000, 24 pp, covers two similar but functionally different types of vertical centrifugal wet-pit pumps. One of these is a heavy duty bilge pump for handling solids-free liquids and drainage; the other is a screenless sewage ejector, constructed to handle sewage and solids-carrying liquid. Booklet also introduces a new lubricating system designed to provide continuous positive lubrication of the pump bearing. Yeomans Brothers Co.

138 Condensed Pump Data — Form 4383-J covers more than 20 types of general service pumps, rotary pumps, sump and drainage pumps, condensate units, self-priming units, stainless steel pumps and high pressure pumps. In easy-to-find tabular form, each model is pictured along with its characteristics, applications, features and references to specific literature providing further information. Lists factors involved in selecting the right pump for the job. Goulds Pumps, Inc.

139 Heater-Pumping Booster for Heavy Liquids — Form AD-104 features the Demo, company's combination tank car heater and pumping booster designed to raise penetration asphalts, tars and other materials to required high application temperatures and deliver them to transfer truck, tank etc. The unit heats and transfers material through the direct oil fired pumping booster. Specifications listed. Cleaver-Brooks Co.

140 Air Compressors — Two-stage radial air compressors producing 80 to 125 lb pressure are described in Bulletin H-630-B1, 12 pp. Gives dimensions and weights of bare compressors, base-mounted multi-V belt driven compressors, and flexible-coupled compressors; also close-coupled compressors. Capacities, sizes, specifications included. Pictured and explained are articulated connecting rod, fan-cooling of isolated cylinders, other design features. Worthington Corp.

PISTON CUPS, SEALS

142 Molded Piston Cups — Complete information on molded cups for pump pistons, hydraulic service and pneumatic equipment is provided in 8-pp Bulletin AD-142. Illustrates various types of cups, gives service data and a full list of sizes and part numbers. Typical applications are also shown. Garlock Packing Co.

143 O-Ring Application — This 16-pp illustrated booklet gives brief but comprehensive data on the manufacture and application of "O-rings" as static and dynamic seals. Groove machining details for static and dynamic applications, both with and without "back up" or "non extrusion" washers, are given in chart form. International Packings Corp.

DIESEL ENGINES

144 Diesel Combustion Handbook — The new second edition of "Lanova Combustion System for Diesels" is a 38-pp illustrated booklet describing in non-technical terms the principles of the internal combustion engine as well as company's controlled turbulence combustion system, its purpose, advantages and application to diesel engines. The Lanova Corp.

145 Diesel Parts — Covering diesel parts made by this company, this catalog includes descriptions of a number of typical replacement parts currently produced, all illustrated by comprehensive detail drawings. Hunt-Spiller Mfg. Corp.

OTHER EQUIPMENT

146 Corrosion-Resistant Fastenings — This 60-pp booklet describes stainless steel and non-ferrous fastenings as used in transformers, switchgear, pole line hardware, other power and process equipment. Gives sizes, prices, packaging information. Also lists most of manufacturer's stock bolts, nuts, washers, cotter pins, screws, rivets and washers. The H. M. Harper Co.

147 Steam Generators — Twenty-pp Bulletin SB43, 20 pp, describes company's VL factory assembled generators combining 2-drum water-tube boiler, integral water cooled furnace, brick work, insulation and steel casing. A large cutaway illustration shows design details, and gas travel, circulation and furnace interior are also pictured. Use of the generator with various fuels and firing arrangements is covered. Erie City Iron Works.

148 What's What on Silicone Rubber — Titled, "Imagineering with G-E Silicone Rubber," 24-pp Bulletin CDS-3 includes comprehensive information on properties, applications, classes and design specifications. Applications illustrated show how properties of this silicone rubber help make new and better products, improve production processes. Chemical Div., General Electric Co.

149 Industrial Insulations — Just released, this 20-pp catalog describes insulating materials covering the temperature range from —150 to 1800 F, and including cement, block, blanket, felt and pipe covering. Complete with thermal-conductivity graphs and heat loss charts, catalog also shows list prices. Brief application descriptions included, also typical uses, sizes, packaging, densities. Baldwin-Hill Co.

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Catalog Library

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PUMPS AND COMPRESSORS

201 **Centrifugal Pump Handbooks** — Two instruction booklets covering the installation, operation and repair of company's single-stage single-suction and multi-stage centrifugal pumps are available. Suggest regular inspection procedures and include pages for maintenance records. Also provide handy tables explaining how to locate trouble and listing causes and cures. Bulletin 08X7813, 24 pp, covers single-stage pumps; Bulletin 08X7780, 48 pp, covers the multi-stage pumps. State choice or both. Allis-Chalmers Mfg. Co.

202 **Centrifugal Pumps** — Twelve-pp Bulletin 715-1 presents manufacturer's support-head type centrifugal pumps, describing and illustrating construction details, and providing performance data, specifications and dimensions. These are single stage, ball bearing, enclosed impeller pumps for direct or belt drive. Goulds Pumps, Inc.

203 **Screw Pumps** — Bulletin S304, 18 pp, describes and illustrates Warren-Quimby screw type rotary pumps. Provides sectional and exterior views, installation pictures, dimensions, engineering and selection data. Warren Steam Pump Co., Inc.

204 **For Controlled Volume Pumping** — Bulletin 300, 24 pp, describes Pulsafeeder piston-diaphragm pumps, stressing their no-stuffing box feature and noting that although basically a pump, this unit can do the work of a chemical feeder, a meter, an instrument, a filling machine, a proportioner and a sampler. Process Equipment Div. Lapp Insulator Co., Inc.

205 **Compressor Selection Chart** — Based on normal applications handling air with atmospheric intake pressure, this chart simplifies selection of proper size compressor, giving quick comparison between discharge pressure pounds per square inch gage and piston displacement cubic feet per minute. Worthington Corp.

206 **Rotary Compressors** — Bulletin C-6 on rotary compressors. Fully illustrated, provides sketches of intake regulator, and bearing and ring assemblies, also photos of installations. Explains operation. Fuller Co.

WATER CONDITIONING

207 **Chlorination for Power Plants** — Form RA-2061-C is a 20-pp technical article, "Recent Developments in Chlorination and Equipment for Power Plants." Discusses such subjects as industrial water chlorination, the declining processes, air pilot chlorinator operation, organic slimes and scales, chlorine ammonia reactions, chlorine residual recording. Wallace & Tiernan Products, Inc.

208 **Water Treatment** — Bulletin 5000, 24 pp, explains the reasons for boiler water treatment and tells services offered by company in providing formulations for individual plant requirements. Covers pre-treatment, internal treatment, treatment application, blowdown adjustment, test control. Describes equipment. Dearborn Chemical Co.

209 **Slurry Type Softener** — Six-pp Bulletin W-212-B6 describes a slurry type precipitating softener and coagulator in which energy for floc preparation is mechanical, explaining and illustrating flow circuit. Question-and-answer appraisal of this system is provided. Worthington Corp.

210 **Carryover Prevention** — Eight-pp Technical Paper 115 discusses the role of anti-foam agents in the prevention of carryover of boiler water solids with steam. Covers mechanical and chemical influences on carryover, foaming and anti-foam action, types of anti-foam agents. W. H. & L. D. Betz.

The postage-free cards may also be used for asking for tear sheets and information on ads or new products

211 **Water Conditioning Data Book** — Recently revised, this pocket-size 116-pp booklet presents a compilation of 77 tables, all valuable to the power engineer. Covers such subjects as hydraulics, impurities in water, boiler feedwater make-up requirements, chemical conversions and chemical reactions. Contains excellent reference information on many phases and methods of water treatment. Available without charge to qualified power engineers. The Permutit Co.

212 **What's New on Ion Exchangers** — Here are three booklets on ion exchangers: Nalcite HCR, a styrene type cation exchanger; Nalcite BAR, a strongly

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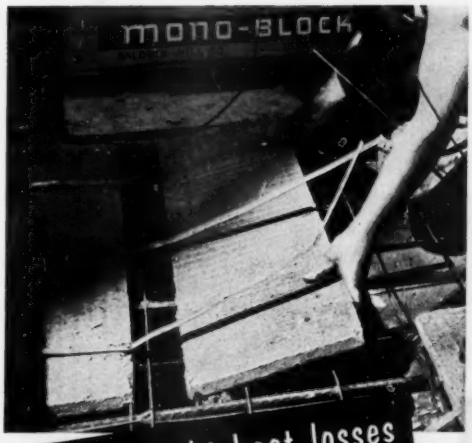

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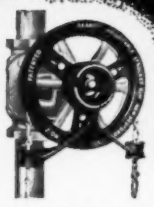

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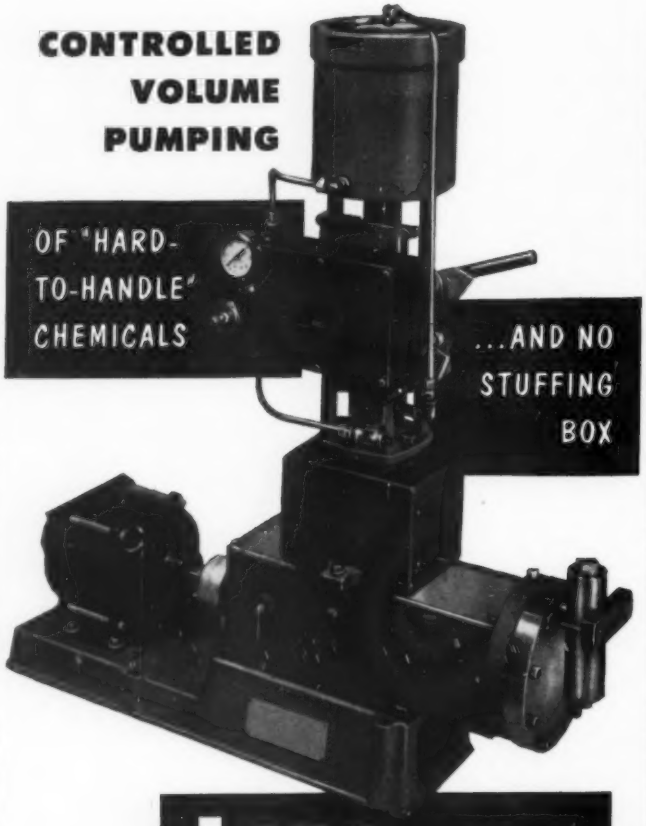

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NEW BULLETIN AVAILABLE. Write for Bulletin 300, just issued. 24 pages of description, specifications, typical applications, flow charts. Lapp Insulator Co., Inc., Process Equipment Division, 582 Maple Street, Le Roy, N. Y.

basic anion exchanger; and Super Nalcolite, a synthetic gel type zeolite for cation exchange. Tables and graphs explain performance of these water treating resins under various operating conditions. Physical characteristics, exchange capacities, regeneration techniques discussed. Bulletin 57, 20 pp, is on Nalcite SAR; Bulletin 58, 28 pp, Nalcite HCR; Bulletin 59, 8 pp, Super Nalcolite. State those wanted. National Aluminate Corp.

213 Modern pH and Chlorine Control — This 100-pp booklet gives details on color comparators and equipment in water testing and control of boiler and industrial process water, also technical information on meaning of pH control, electrometric and colorimetric methods of determining pH and impurities in water; applications of water control in air conditioning; treating boiler feed water. W. A. Taylor & Co.

214 Water Conditioning Bulletin — This is an 8-pp discussion of water and the chemicals developed for conditioning it to control scale and algae and inhibit corrosion. Describes several chemicals in detail, giving properties, composition. Wright Chemical Corp.

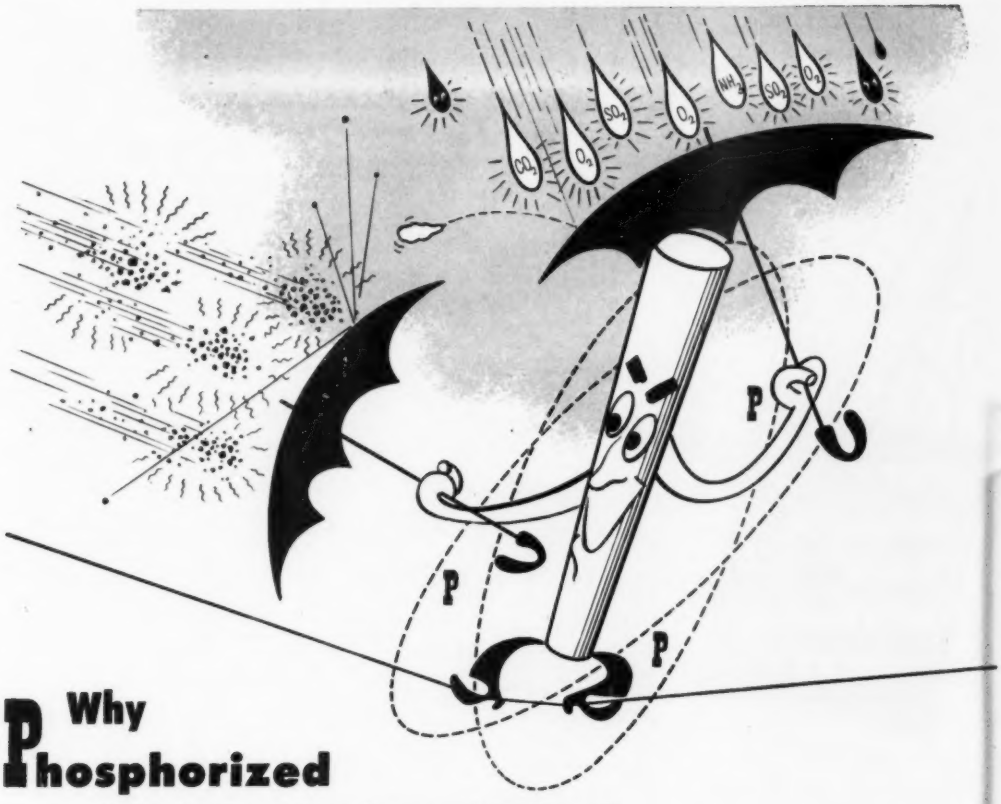
215 Feedwater Treatment — Here is a 10-pp illustrated report on boiler feedwater treatment for a high-pressure, high-makeup power and steam producing plant. It is based on studies to determine best method of meeting requirements for both the high-pressure steam used in power generating turbines and the district heating steam for downtown Philadelphia. Reasons for deciding on a demineralizing plant are given. Graver Water Conditioning Co.

216 Water Conditioning Information — Here are three informational bulletins. No. 28X7446 describes a simple way to determine total hardness in water, illustrating procedure. No. 28X7559 gives an analysis of the hot process-hot zeolite system telling results to be expected. No. 28X4766 discusses current status of embrittlement in boilers, explaining causes and control methods. List bulletins wanted. Allis-Chalmers Mfg. Co.

217 Corrosion Treatment — "Corrosion Protection of Steam and Condensate Return Systems" is a folder on amine treatment for boiler and condensate systems. This treatment is described as affording surface protection of the metal as well as raising pH value of condensate. The Bird-Archer Co.

218 Steam System Treatment — This bulletin on Coravol for prevention of corrosion, explains theory of corrosion, application of organic amines to steam systems (the Coravol process) and presents case histories of use in different types of plants and industries. Coravol is part of a complete technical service providing special chemical formulas for treatment of water, steam, brine, fuel. Western Chemical Co.

219 Boiler Water Manual — Factual information on methods of applying chemicals in treatment of water for boilers is presented in 16-pp Standard Method 122. Discusses pretreatment of raw water, application of chemical feeding to pretreating operations and both constant rate and flow responsive feeding direct to boiler drum and to feed-water system, condensate returns, % Proportioneers, Inc. %



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220 One-Minute Water Tests — Rapid, simple and accurate tests for determining water hardness are described in Bulletin 1RE50. Procedures, reagents, and equipment are described. Hall Laboratories, Inc.

FUEL OILS, LUBRICANTS

221 Cooperative Technical Consultation Service — This informative 24-pp booklet presents company's periodic consultation service aimed at the most efficient use of petroleum products. Covers services available in the solution of lubrication problems, metalworking operations, processing, fuel oils, dust control. Gulf Oil Corp., Gulf Refining Co.

222 Air Compressor Lubrication Manual — Valuable information on air compressor maintenance is contained in this 40-pp book. Subjects treated include compressed air, compressors and related equipment, lubricating systems, compressor oils and applications, lubrication requirements, operating hints, oil requirements, storage and care of compressor oils, safety precautions. Cities Service Oil Co.

223 Lubrication of Diesel Engines — An excellent instruction manual, 50-pp Technical Bulletin B-1 (revised) also provides a brief history on diesel engines, an explanation of the fundamentals of design and the common types of diesels and their advantages. Explains combustion process, discusses modern fuel injection systems. Cylinder and bearing lubrication are treated and recommendations given for lubricating oils. Sun Oil Co.

224 Diesels, Their Fuels and Lubricants — This 46-pp book gives practical information on diesel engines, covering their history and economics as well as design characteristics and operating principles. Classification of diesels according to their speed is also explained. Sinclair Refining Co.

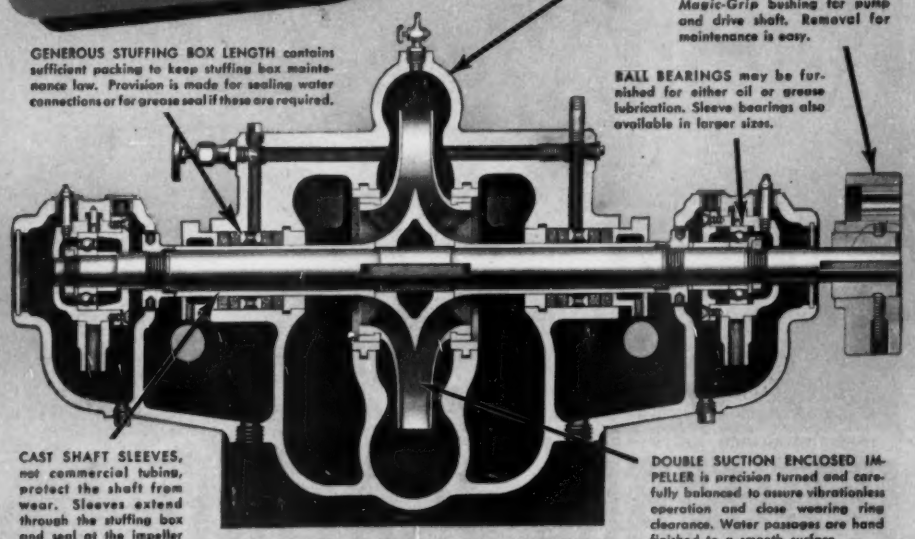
225 Clean Oil for Diesels — A combination purifying and filtering unit utilizing centrifugal force and controlled filtration is the subject of illustrated Bulletin DL-1. Explains operation of the unit, tells advantages. Discusses importance of clean, dry lubricants. The De-Laval Separator Co.

226 Versatile Industrial Oil — Described in 20-pp Form AD 4078 is an all-purpose oil offering protection for a wide range of industrial equipment, and available in 15 viscosity grades. Discusses six major characteristics of the oil; explains and pictures its use in hydraulic systems, speed reducers, air compressors, electric motors, hydraulic turbines, bearing systems etc. A chart shows grades available, their uses and physical properties. Standard Oil Co. (Ind.)

227 Viscosity of Fluids — The larger significance of viscosity is discussed in Nos. 5 and 6, Vol. 36 of Lubrication, a technical publication. In six parts, the first illustrates simplest conception of streamline flow between two surfaces having relative motion. Part II covers streamline flow in capillary and other small tubes. Part III covers turbulent flow in pipes. Part IV discusses effects of temperature and pressure on viscosity, and Part V includes viscosity index. Part VI provides a brief reference to the nature of plastic flow. The Texas Co.

ALLIS-CHALMERS

Double Suction PUMPS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HEAVY, HORIZONTAL SPLIT CAST IRON CASING construction with suction and discharge nozzles located in lower half for easy inspection without disturbing piping.
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GENEROUS STUFFING BOX LENGTH contains sufficient packing to keep stuffing box maintenance low. Provision is made for sealing water connections or for grease seal if these are required.
BALL BEARINGS may be furnished for either oil or grease lubrication. Sleeve bearings also available in larger sizes.
CAST SHAFT SLEEVES, not commercial tubing, protect the shaft from wear. Sleeves extend through the stuffing box and seal at the impeller hub.
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228 Turbine Oil Conditioning — Bulletin 832-P, 12 pp, offers a detailed explanation of the reasons for turbine oil conditioning, the way in which company's dry type conditioning equipment nullifies or prevents factors which promote deterioration of oil. Bowser, Inc.

COAL, ASH HANDLING

229 Spreader Stoker Data — This is a file of three illustrated bulletins on spreader stokers. The first discusses seven reasons for selecting these stokers and describes their design, construction and operation; the second, dumping grates, the third, installations. Riley Stoker Corp.

230 Where Refuse Is Fuel — Presented in 24-pp Bulletin are installations of company's stokers with medium-size and larger units burning refuse fuels, separately or in combination with coal. Lists many of the refuse fuels handled successfully by this type of spreader stoker. Detroit Stoker Co.

231 Coal Scale — Bulletin 0250, 12 pp, describes a pressure-tight, automatic coal scale, its construction and operation. Shows how beam system, electrical components and linkages are protected from exposure to coal dust. Richardson Scale Co.

232 Spreader Stoker Selection — Fourteen-pp Form F-520-A10M is intended to help those choosing a spreader stoker to get the most for their investment, and it points out many factors to be considered. American Engineering Co.

233 Coal Handling Equipment — Modern equipment for the storage and handling of coal and ash is presented in 24-pp Bulletin 300. Illustrated, covers concrete and tile silos, cylindrical steel tanks, suspended bunkers. Gifford-Wood Co.

VALVES, TRAPS, PIPING AND ACCESSORIES

234 Check Valves — Twenty-pp Catalog 30 presents company's line of tilting-disc check valves made in iron, bronze and steel for working pressures to 3000 psi. Explains operating principle of tilting disc construction, discusses closing without slam, reduced loss of head, other advantages. Includes construction details, sizes. The Chapman Valve Mfg. Co.

235 Gate Valves — Literature is available on cast steel outside-stem-and-yoke gate valves; also on bronze, iron, steel and corrosion-resisting valves in a variety of types. The Wm. Powell Co.

236 To Get at Those Valves — This little folder describes a sprocket rim with chain guide. The rim adjusts to fit all sizes of valve wheels. Babbitt Steam Specialty Co.

237 Iron Body Gate Valves — Bulletin 805, 8 pp, covers iron body, bronze trim gate valves in both outside screw and yoke and non-rising stem types, telling applications for each. Design features are explained. Gives dimensions, working pressures, and prices. The Ohio Injector Co.

238 Blow-off Valves — Illustrated Bulletin B-433, 24 pp, describes blow-off valves for high-pressure boilers, and covers seatless, hard-seat and unit-tandem types, for working steam pressures from 400 to 2500 lb. Construction details and operating principles illustrated. Di-

TORTURE CHAMBER

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B-812

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No contact with moving parts is required. Just touch the instrument to the chassis, frame or housing of the machine or motor and read the rpm directly. No moving parts. No lubrication or maintenance required. Accurate to ½ of 1%, they will operate continuously for years without any appreciable change. Instruments with limited ranges available for as little as $27. Practically any desired range within 900 and 100,000 rpm can be supplied. **BULLETIN 41-PE.**

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mensions and specifications included. Yarnall-Waring Co.

239 General Service Valves — Bulletin E-160, 16 pp, describes and illustrates design and construction of company's quick-operating valves, explaining their application to blow-off service and on chemical process, soot blowers, water column blow-down, and other types of pipe line. Everlasting Valve Co.

240 High Pressure Gate Valve — Described in 4-pp Form DH-273 is a forged steel gate valve designed for long service and low cost maintenance. Working pressures, sizes and prices listed. R-P & C Valve Div., American Chain & Cable Co., Inc.

241 Valve Specialties — Included in 90-pp Catalog A-50 is ordering and engineering information on automatic pressure flow and liquid level controls for steam, air, gas water, oil, other fluids. Sections are devoted to pressure regulators, altitude valve, pump governors and strainers; lever, float and motor operated valves; pilot valves; back pressure, relief and non-return valves, stream trap and air vent; liquid level controllers; solenoid valves. Davis Regulator Co.

242 Popular Steel Valves — Condensed Catalog 104, 28 pp, describes and illustrates most widely used of company's cast and forged steel valves and the data presented for these valves is complete. Those listed are chiefly in the basic steam pressure classes — 150 to 2500 lb — and include globe and angle, gage, instrument, hydraulic and relief types, also strainers and check, gate, non-return and blow-off valves. Edward Valves, Inc.

243 Air Release Valves — Bulletin 1200, 8 pp, presents air release valves for water, sewage and industrial use. Explains essential requirements for this type of valve; illustrates methods of installation. A large cutaway drawing accompanies discussion of the operating and construction details. Standard high pressure and special types described, dimensions given. Simplex Valve & Meter Co.

Postage-free cards for ordering catalogs and bulletins are provided on pages 38 and 138

244 Pressure Reducing Valves — Selection and engineering data on pressure reducing valves, including those for remote control of reduced steam or water pressures, are in 12-pp Bulletin 477-A. Northern Equipment Co.

245 Steam Trap Book — Catalog J is the 44-pp new edition of this company's popular trap book and serves as a manual of trapping practice. Includes a catalog section giving physical data and prices on cast semi-steel and forged steel inverted bucket steam traps, compound steam traps and ball float air and air relief traps; a handbook section explaining how to calculate condensate loads and select traps for all classes of equipment; a maintenance section explaining trap installation, trouble-shooting and repair. Armstrong Machine Works.

Sun Valley, Idaho

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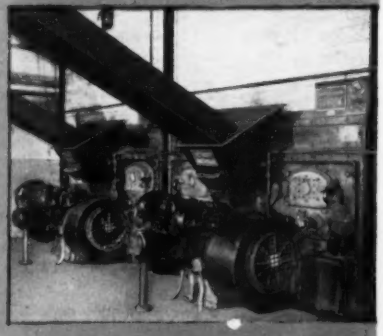

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246 Steam Trap Reference Manual — Bulletin T-1740, 24 pp, tells why and where steam traps should be used; explains desirable trap features. Advantages of company's impulse steam traps are described, their operation illustrated. How to figure trap sizes and how to size condensate return lines are told and capacity and pipe dimension charts and thermodynamic properties of saturated steam included. Also provided are installation and operating suggestions, prices. Yarnall-Waring Co.

247 Steam, Air and Gasoline Traps — Illustrated Catalog 751, 32 pp, provides capacity tables, installation diagrams and a section containing data, charts and formulas for determining proper size trap for specific applications. Covers thermostatic steam traps for pressures to 225 lb, expansion steam traps, weight-operated traps for steam, air and gasoline as well as piston-operated steam traps. W. H. Nicholson & Co.

248 Solving Steam Trap Problems — This popular 36-pp catalog on steam traps contains specifications and capacities on steam traps, float traps, air release valves and pipe line strainers. Tells how to calculate condensation loads and select traps for all classes of equipment, including unit heaters, jacketed kettles, autoclaves, submerged surfaces, steam mains and header drips. Gives pointers on how to install and service traps. The V. D. Anderson Co.

249 Piping Pointers — This is company's highly popular 36-pp manual covering fundamentals of sound piping practices. Discusses various types of valve designs and how each should be used. Pictures and names more than 80 fittings and contains illustrated how-to-do-it features. Includes 8 pp valve selection guide. Crane Co.

250 Duplex Strainer — This literature describes company's Duplex strainer with single handwheel control. Shows how it is designed with only one stuffing box and can be cleaned under full flow. R. S. Products Corp.

251 Valves, Fittings and Flanges — Catalog F-9 is a 400-pp, permanently bound reference book on drop forged steel valves, fittings and flanges for practically all piping needs at high and low pressures and temperatures. Provides ordering information on company's complete line, also much helpful engineering and application data: includes a section on products for refrigeration service. Available to qualified power engineers; please give your title. Henry Vogt Machine Co.

252 Design Properties of Pipe — This 12-pp booklet consists of tables listing pipe sizes and wall thicknesses currently established as standard, plus dimensional properties of commercially available sizes of steel pipe. Tube Turns, Inc.

253 Handbook on Fittings, Flanges — Catalog wf-1950, 68 pp offers working information on seamless carbon steel welding fittings and forged steel flanges. Includes dimensional tolerances, thread standards and threading practice; service pressure ratings, physical and chemical requirements. Grinnell Co., Inc.

BOILERS, GENERATORS

254 Shop-Assembled Boiler — Sixteen-pp Bulletin G-76, completely describes and illustrates company's Type

STOP CORROSION

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Unretouched photograph shows the ravages of corrosion on condensate return lines.

Corrosion of piping in steam and condensate return lines is an expensive two-way headache. (1) It leads to large outlays for pipe replacement and maintenance. (2) It often results in plugged return lines and traps due to the solid products of corrosion. Bird-Archer Amine Treatment effectively eliminates these troubles at low cost.

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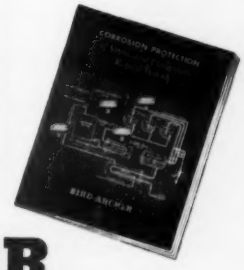
gives all the facts on Bird-Archer Amine Treatment. Write for your copy.



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BA 166

FM water-tube integral-furnace boiler, made in standard sizes from 2900 to 28,000 lb of steam per hr, pressure to 250 psi. Savings in erection, installation and moving costs are stressed along with wide range of applications. Capacities, dimensions and weights are given along with efficiency data. The Babcock & Wilcox Co.

255 Re-Circulation Steam Generator — Here's a 6-pp folder on a controlled re-circulation steam generator, describing its development and uses, such as applications where steam is required in remote locations, where demands are intermittent, or load fluctuating. Combustion Engineering-Superheater, Inc.

256 Steam Boilers — Form SG 128–749 is a 12 pp catalog illustrated with photos of steam boilers for processing and heating, ranging from 15 to 500 hp and 15 to 200 psi. Includes diagrammatic cross-section of four-pass design characteristic of manufacturer's boilers. Cleaver-Brooks Co.

257 Two-Drum Boilers — This new 16-pp bulletin describes two-drum boilers on the integral furnace type, giving information and dimensional data on company's 3-VC and 4-VC designs, both available for oil, gas or stoker firing. Typical installations for various types of firing are shown, construction details included. Erie City Iron Works.

TUBING

258 Double-Walled Tubing — Technical Bulletin 1950, 12 pp, presents tubing designed for conditions where single-walled tube can't withstand simultaneous attack from two types of corrosive media. Describes and illustrates construction, illustrating possible metal combinations. Explains tubing's use in ammonia refrigeration, boilers, steam generators. Discusses heat transfer properties, high temperature use. Bridgeport Brass Co.

259 Life Extension for Condenser Tubes — This 32-pp extensively illustrated booklet reports on research into the causes of corrosion and means of combating them, as well as the choice of condenser tube materials. Points out that Admiralty metal, long a standard for power plant condenser tubes, works satisfactorily in most installations, but other alloys may be necessary in some circumstances. Revere Copper and Brass, Inc.

260 Nickel Pipe and Tubes — Bulletin T-17 is a 27-pp technical bulletin on the fabrication and design of nickel and high nickel alloy pipe and tubing, illustrated throughout by drawings and photos. Presents tables on mechanical and physical properties, ASME code requirements, recommended welding procedures. The International Nickel Co., Inc.

261 Condenser Tubes — Excellent factual information on condenser tubes and their service life is given in this 40-pp illustrated booklet. Subjects discussed include corrosion of condenser and heat exchanger tubes, corrosion resistance and control, the selection of tube materials, and the composition and physical properties of company's alloys. Details on proper tube installation are presented, as are specifications, conversion tables, weights of tubes and alloys, formulas, terminology. Scovill Mfg. Co.

TOOLS

262 Pipe Tool Book — This catalog and data book gives information on pipe and bolt machines, power units, ratchet threaders, reamers and cutters, other power and hand tools. Includes "operating guide" Beaver Pipe Tools.

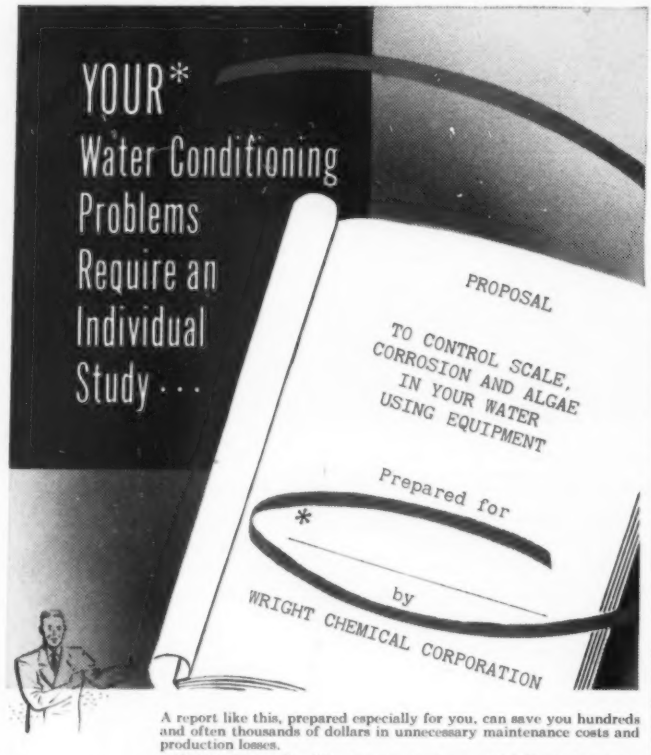
263 Rotary Tube Cleaners — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads, discussing special features. Roto Div., Elliott Co.

264 Tube Cleaners — Catalog 76-A provides 48-pp of information on manufacturer's line of tube cleaners. Following equipment selection and operating hints, this practical catalog describes and pictures cutter heads and drill heads, brushes, and motors, giving sizes, application information. Electrically driven equipment, air valves, hose, lubricators presented. Thomas C. Wilson, Inc.

INSTRUMENTS AND CONTROLS

265 For Centralized Control — Bulletin 109 presents compact Mini-Line equipment suited to control board arrangement which concentrates vital operating information and controls for one or more boilers, turbines or process units before a single operator. Describes vertical-scale indicator units, selector valve, remote manual relay. Bailey Meter Co.

266 Instruments Control Systems — Twelve-pp Catalog 513 presents manufacturer's line of instruments, control systems, regulating valves and desuperheaters. Covers draft and pressure instruments, boiler meters, recorders, thermometers, regulators, combustion controls, pump controls and many others. Republic Flow Meters Co.



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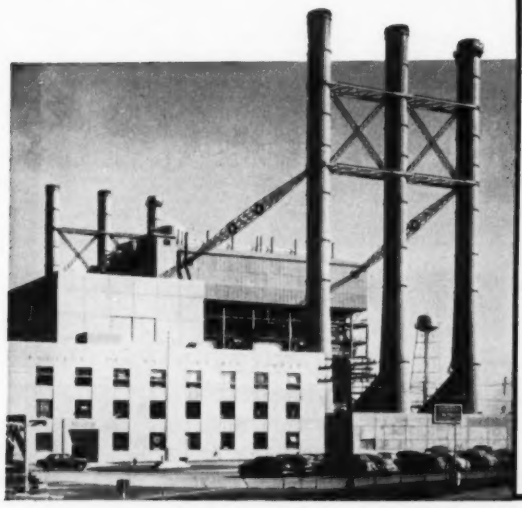

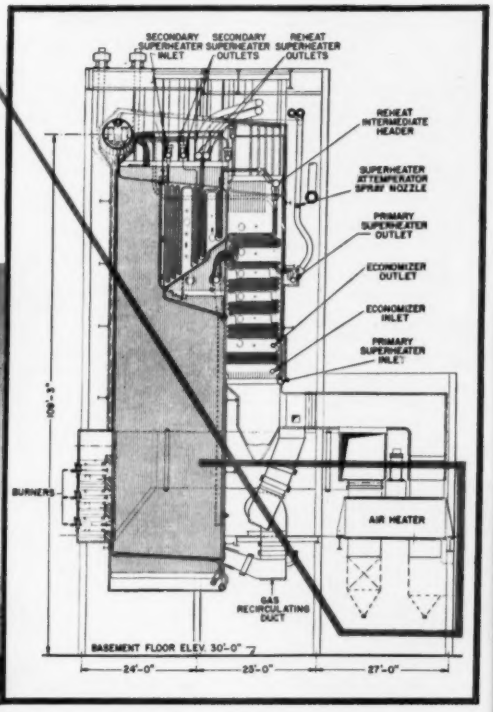

In the country's largest single utility expansion program, costing more than one billion dollars, Pacific Gas and Electric Company is boosting its power capacity by more than 2,500,000 kilowatts. One of the five steam power plants in this program is P. G. and E.'s Moss Landing Steam Plant, designed and constructed by Stone & Webster Engineering Corporation, under the supervision of the P. G. and E. Engineering Department.

Three of a projected five 100,000-kw turbines are in operation now at Moss Landing. Steam for each of these three turbines is supplied by two 475,000 pounds of steam per hour Babcock & Wilcox Radiant Boilers with superheater outlet conditions of 1405 psi and 950 F. The two turbines yet to be installed will each be powered by one B&W reheat boiler (illustrated), designed to generate 850,000 lb of steam per hr at 1450 psi and 1000 F, reheated to 1000 F.

Each of the boilers at Moss Landing has been designed to incorporate a Ljungstrom Air Preheater. Those now in use preheat incoming air to 575 F, and cool exit gases to 350 F. Ljungstroms will be used also for the boilers being built.

Moss Landing is another in a long series of new stations and expansions to existing stations where Ljungstrom Air Preheaters have been specified for high-performance steam generating units. The unanimity with which the Ljungstrom has been accepted by boiler manufacturers, consulting engineers, and power companies is demonstrated by the fact that over 285,000,000 pounds per hour of steam capacity since 1945 has been served by Ljungstrom Air Preheaters.

THE Air Preheater Corporation 60 East 42nd St., New York 17, N.Y.

267 Easy Reading Gage — An all-hydrostatic remote reading gage for boiler water and other liquid levels is described in Catalog 500, Section CO. Pictures improved visibility, other advantages offered by this gage, explains operation. The Reliance Gauge Column Co.

268 For Combining Control Signals — The improved design of company's Ratio Totalizer is described and pictured in color in 8-pp Bulletin 5452. This simplified versatile mechanism is a pneumatically operated control for combining input control pressures and spring forces, and producing an output control pressure based on addition, subtraction, multiplication, division or other functions. Hagan Corp.

269 Fundamentals of Instrumentation — Booklet 80-2 offers 126 pp of information on instrumentation in industry. Separate sections are devoted to the fundamentals of measurement and control, measurement of process variables, remote transmission of measurements, automatic controllers, power units and final control elements, control systems and panel-boards. Typical applications are also discussed. Generously illustrated. Available to qualified power engineers. Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

270 For Practical Men — This 24-pp pocket-size booklet presents insulation testing in simple language. Packed with maintenance hints, explains electrical insulation, tells how it can be tested and what makes it go bad. It describes the Megger insulation tester and justifies its cost in long run economy. James G. Biddle Co.

271 Temperature Instruments — This 100-pp catalog gives details about company's complete line of industrial glass, dial and recording thermometers, electronic temperature indicators and recorders. Fully illustrated, includes application information. American Industrial Instruments, Manning, Maxwell & Moore.

272 Temperature Regulators — Twelve-pp Bulletin T, Catalog 80, describes manufacturer's line of regulators for controlling temperature of liquids and gases, giving their applications, operating characteristics, construction specifications, dimensions. Foster Engineering Co.

PACKINGS, GASKETS, SEALS

273 Manual on Packings — Containing 84 pp of engineering and ordering information, Catalog 40 covers packings for practically every service. Includes packaging recommendation charts, conversion tables. The Belmont Packing & Rubber Co.

274 Packings and Gaskets — Catalog P-100C, 32 pp, covers 95 most popular packings and gaskets in company's line, furnishing details of construction, service recommendations and size information. Includes charts showing specific recommendations for a wide variety of applications. Packing Div., Raybestos-Manhattan, Inc.

275 Packings for the Power Plant — Designed as a quick-reference aid, one feature of this compact 6-pp guide is a flow sheet of a rudimentary industrial power plant with each unit keyed to the proper packings and gaskets. These, in turn, are illustrated with photos and construction information, sizes, etc. Packings and gaskets are grouped according to recommended applications and services. Johns-Manville.

276 Seals for Bearings — Complete information on manufacturer's Klozure oil and grease seals for bearings is available in 100-pp Catalog 10. Fully illustrated in color, pictures all types of these seals, typical applications and lists sizes and part numbers. Also describes mechanical pressure seals for rotary shafts. The Garlock Packing Co.

277 To Pack Against Acid — A packing that is chemically resistant to all acids, alkalies and caustics is described in this literature. Tells how packing incorporates both asbestos and Teflon in its construction, stresses advantages. A. W. Chesterton Co.

REFRACTORIES, INSULATION

278 Refractory Brick — Electric furnace fused refractory bricks and their use is described in Form 862, 16 pp. Gives installation procedure on a high quality silicon carbide brick for boiler furnaces and gas generators. Also provides information on a fused aluminum brick. Norton Co.

279 Heat Insulation — This 8-pp booklet on hydrous calcium silicate insulation is illustrated with graphs, tables and drawings showing the numerous ways in which this insulation is used in industrial and commercial projects for temperatures up to 1200 F. Lists wide selection of shapes and sizes to insulate tubes and pipes from ¼ to 72 in. dia and vessels from

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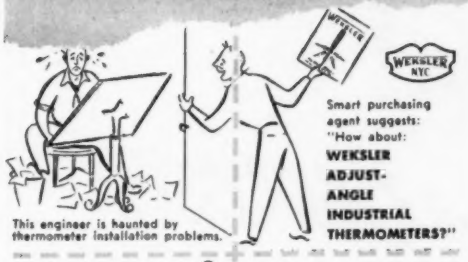
The Case Of The Haunted Engineer



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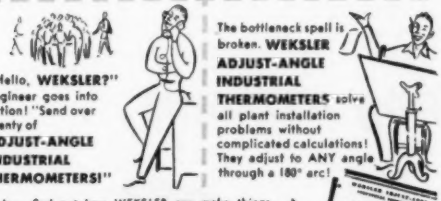

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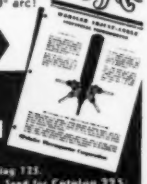

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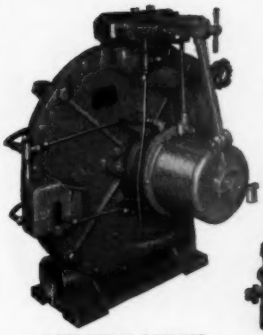

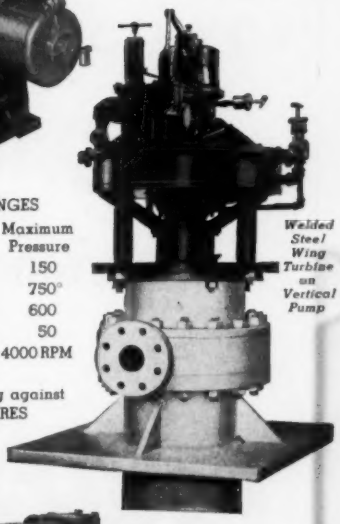

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	Standard	Maximum Pressure
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Temperatures	525°	750°
Pressures	275	600
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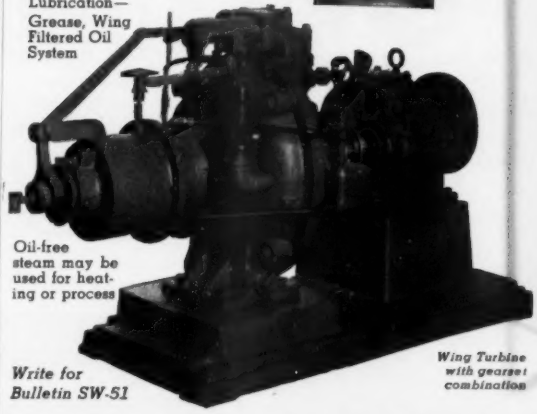

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Wing Turbine with gearset combination

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72 in. to 60 ft, also flat surfaces. Gives data on physical characteristics, recommended thicknesses. Kaylo Div., Owens-Illinois Glass Co.

280 Heat Insulation Data — This is a 12-pp illustrated engineering and specification manual describing applications for 85 per cent Magnesia heat insulation. Provides data on heat savings per pipe thickness, for heat ranges to 600 F. Includes charts for determining thickness standards for pipe covering, with tables for heat calculations. Mundet Cork Corp.

FUEL BURNERS

281 Gas Burners — Illustrated Bulletin 410-8, 16 pp, furnishes descriptive and technical data on company's gas burners and combination gas and oil burners, giving design details and explaining operation of each type. Coppus Engineering Corp.

282 Steam Atomizing Oil Burners — Sixteen-pp illustrated Bulletin 21 describes steam atomizing oil burners and auxiliary equipment for use with heavy oil or tar in boilers, stills, dryers and other furnaces, where steam or compressed air is available for atomizing the oil. Discusses steam and oil control valves. National Airoil Burner Co., Inc.

283 Oil Burning Equipment — Bulletin O-B 37 contains 16 pp of technical information on company's oil and gas burning equipment, steam atomizing burners, mechanical atomizing burners, interchangeable burners, telling best applications, including capacity data. Also shows fuel oil pumping, heating systems. The Engineer Co.

OTHER EQUIPMENT

284 Friction Tape — Three types of friction tape are described as to properties and application in Form M-8343. They include a high grade tape for all electrical work, a good general purpose tape that's competitively priced and available in two widths, and an extra strong tape. United States Rubber Co.

285 Ejector Instruction Manual — Bulletin J-50-7 is a 36-pp handbook covering operation, selection, installation and maintenance of steam jet air ejectors. Discusses twin and triple element ejectors, surface and jet inter- and after-condensers, isolating valves, drain traps, steam and back pressures, steam nozzles. Foster Wheeler Corp.

286 The ABC of CO_2 — An interesting text covering role of carbon dioxide in combustion efficiency, 16-pp illustrated Bulletin 452 discusses theoretical vs practical perfection of combustion and tells how to determine percentage of CO_2 in flue gases. CO_2 as a basis for figuring heat and fuel losses is also described and method of determining such losses explained. Included scales of total heat losses of various types of fuel. The Hays Corp.

287 Magnetic Drive Engineering Data — Publication 1107 is a 32-pp booklet on precision speed control with adjustable speed magnetic drive. Technical in scope contains information on both magnetic drive and company's magnetic amplifier Regutron speed control. Data is clarified through charts and diagrams. Electric Machinery Mfg. Co.

288 Soot Blower Head — Illustrated Bulletin 485 describes a rotary soot blower head for improved boiler clean-

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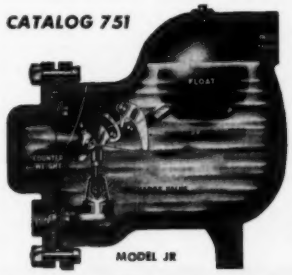

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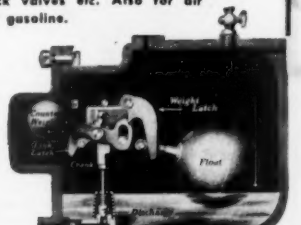

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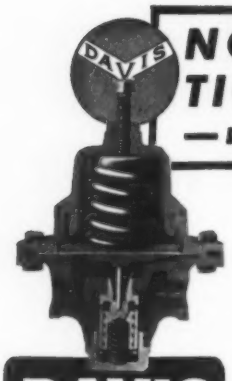

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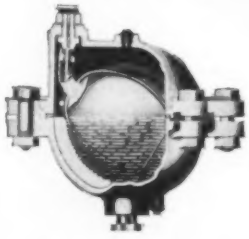

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289 Air Preheaters — Illustrated Bulletin A-11610, 8 pp, defines air preheat and explains its benefits in terms of increased efficiency and capacity and flame stability. Provides general description of company's Ljungstrom preheater, discusses its use in boiler plants. The Air Preheater Corp.

290 Chemical Cleaning Service — Reduced maintenance costs and outage time are among advantages of company's chemical cleaning service for steam equipment and water lines discussed in this 8-pp bulletin. Before-and-after photos show some actual cleaning jobs and several case histories are given. Company's service procedure and facilities outlined. Dowell Inc.

291 Turbine Generators — Bulletin H-18, 40 pp, covers turbine-generators of 500 kw and above, pictures nearly 50 turbine-generator installations, both utility and industrial. Brief discussions of generator and exciter cooling methods are included. A reference section offers detailed drawings showing a typical turbine condenser installation arrangement. Elliott Co.

292 Electrical Maintenance Tips — Booklet B-5477, 28 pp, gives a complete outline of preventive electrical maintenance. Discusses general maintenance programs designed to reduce shutdown time and treats in detail the maintenance of power equipment. A suggested schedule of work and cleaning on power equipment is presented in chart form. Essential information on preventive maintenance for turbines, generators, switchboards, motors, controls is provided. Westinghouse Electric Corp.

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293 Synthetic Coatings — Specially engineered coatings for use in pump rehabilitation, condenser tube and sheet protection, valves, concrete, steel and transite piping, and condenser sealing are discussed in illustrated bulletin. Also describes an acid-proof coating for cooling tower structures. Synco Corp.

294 Transmission Belting — Catalog M-9922, 28 pp, gives design, engineering and performance data on transmission belting. Tables on belt speeds, arc of contact, friction, horsepower correction, service. United States Rubber Co.

295 Dowtherm Vaporizer — Bulletin No. 48-2, describing manufacturer's Type "A" Dowtherm Vaporizer, tells how this unit is designed to evaporate Dowtherm to provide dependable operation at maximum temperatures. The Wickes Boiler Co.

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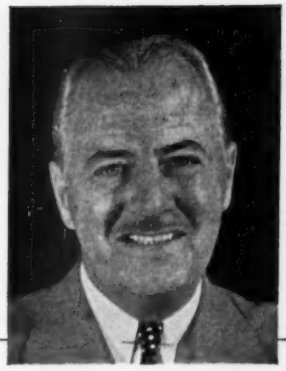

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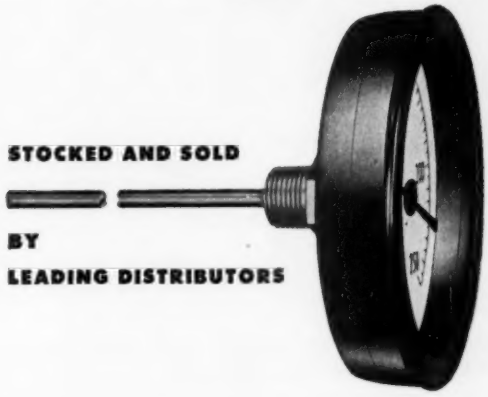

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297 Controlled Volume Pumps—Bulletin 351, 16 pp, describes company's air-powered controlled volume pumps, designed to pump practically any liquid in measured volumes accurate to within a fraction of 1 per cent. Pumps are reciprocating, positive displacement plunger types. Cross-sectionals show design and operating details. Controls and typical automatic feed systems are discussed. Air consumption and capacity-pressure tables included. Milton Roy Co.

298 Industrial Thermometers—Catalog 125, 28 pp, presents ordering data on a wide range of industrial thermometers, giving scale ranges, dimensions and prices. Features company's Adjust-Angle thermometer designed for use at any angle front to back, left or right, through an 80 deg arc. Gives construction details and advantages of this adjustable-stem type instrument. Weksler Thermometer Corp.

299 Mechanical Draft Fans—Mechanical draft fans for both forced and induced draft service are described in 20-pp Bulletin 168. Illustrated with drawings of typical fan types and photos of installations, includes performance curves showing efficiencies of various types of fans. Gives construction features, drive arrangements. The Green Fuel Economizer Co., Inc.

300 Boiler Feed Pump—A barrel-type boiler feed pump for high pressure, high temperature service and designed to go on the line quickly without preliminary warm-up, is the subject of 12-pp Bulletin 1525. Fully illustrated text explains automatic operation of hydraulic thrust balance incorporated in this pump. De Laval Steam Turbine Co.

301 Graphitization Research Study—This interesting 12-pp booklet discusses graphitization phenomena in systems operated at high temperatures in the power and processing industries. Based on a 10-year research program, this study covers nature of graphitization and its effects and lists preventive and corrective measures. Illustrated with photomicrographs pf metallurgical specimens, booklet also contains eutetic diagrams and graphs showing effect of temperature, time and other variables. Edward Valves, Inc.

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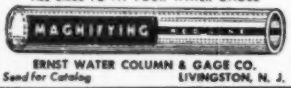

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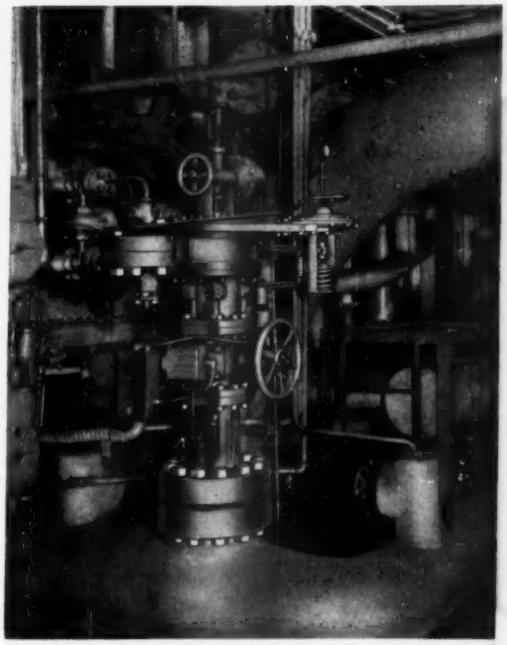

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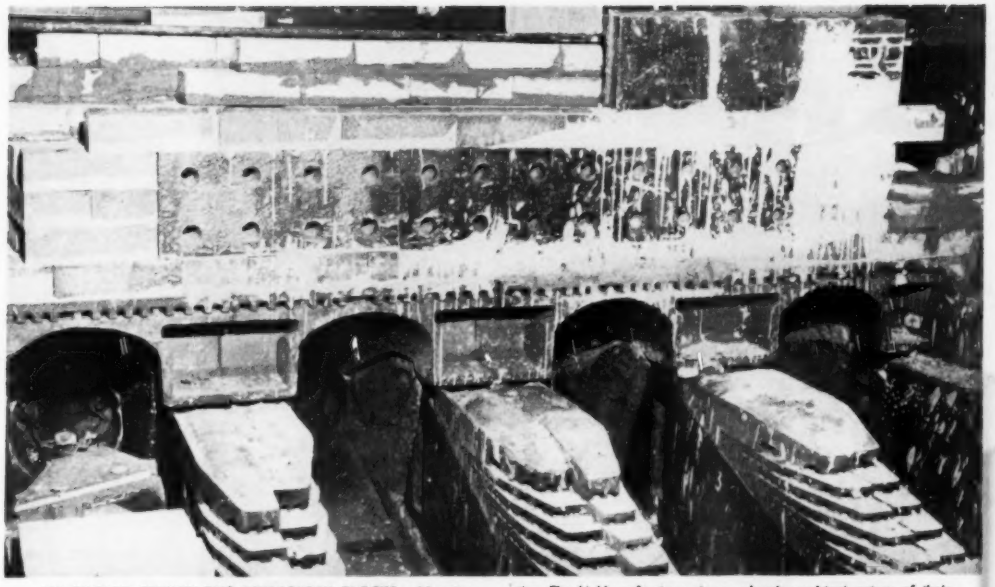


AIR-COOLED CRYSTOLON* REFRACTORY BLOCKS add extra life to the front wall of this boiler-furnace, fueled by multiple retort stokers. Mating tongues and grooves of these blocks simplify construction. The highly refractory, dense, abrasion-resistant nature of their CRYSTOLON refractory composition promises years of service with minimum down-time for maintenance.

How to get EXTRA power from SPECIAL refractories

Every time you shut down a boiler to repair spalled, eroded or cracked walls, you lose power you can never get back.

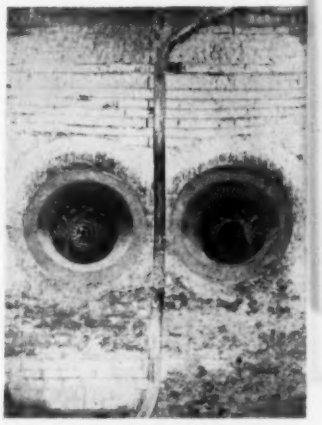
That's why it pays to keep maintenance interruptions at an absolute minimum with refractory blocks and bricks engineered to fit your exact requirements.

That's where your nearby Norton representative enters your power picture. To help you get the most power out of your boilers, he is ready to call on the research resources of Norton . . . pioneers for 40 years in the development of special refractories for complicated high-temperature applications.

Whether your power requirements call for air-cooled blocks or solid brick, you can be sure that the Norton CRYSTOLON refractories you get will give you the greatest resistance to the four common causes of boiler wall failure.

1. ***Temperatures up to 2900° F*** have little or no effect on Norton CRYSTOLON blocks and bricks.
2. ***Slag can't penetrate*** their dense structure.
3. ***Clinker adhesion is so slight*** that clinkers can be easily removed without damage to surfaces.
4. ***Abrasion of moving fire beds*** of stoker-fired furnaces has little or no effect on CRYSTOLON silicon carbide . . . itself a tough abrasive.

For more complete information about Norton CRYSTOLON refractories and the Norton Service that engineers them to your exact requirements, consult your nearby Norton representative, or write direct to Norton Company, 624 New Bond Street, Worcester 6, Mass. Canadian Representative: A. P. Green Fire Brick Co., Ltd., Toronto, Ontario.



THESE BURNER RING PORTS for oil or powdered fuel firing of a power boiler are made of a Norton CRYSTOLON refractory cement, especially designed to resist high temperatures and abrasive action.

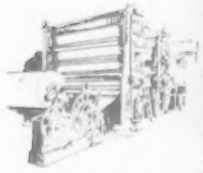
NORTON

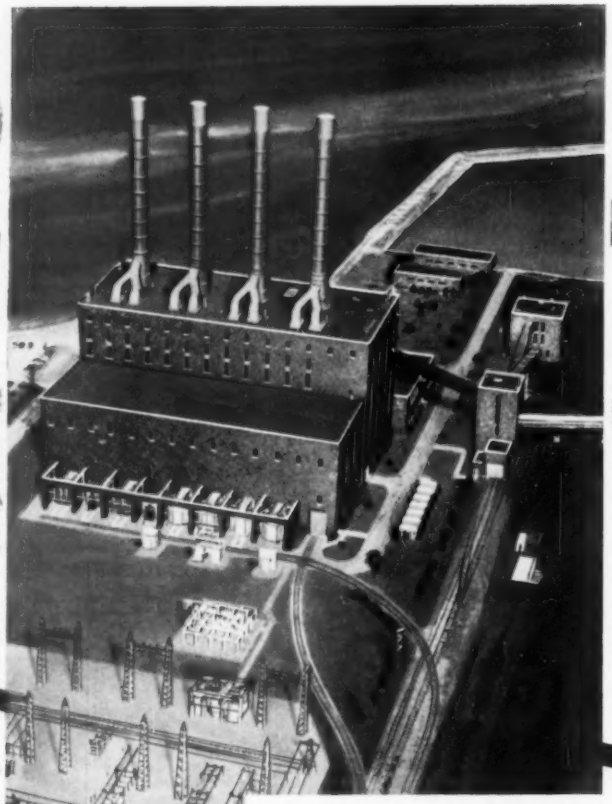
Special REFRACTORIES

Making better products to make other products better

NORTON COMPANY, WORCESTER 6, MASSACHUSETTS

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries





NIAGARA FALLS

BUFFALO

DUNKIRK

SCHENECTADY

ALBANY

OSWEGO STEAM STATION

as enlarged by the fourth 80,000 kw unit. One of 88 steam and hydro electric plants of Niagara-Mohawk Power Corporation.

PRIVATE ENTERPRISE *In Action*...

The Niagara-Mohawk Power Corporation has 7000 circuit-miles of transmission lines and 85,000 conductor-miles of distribution lines in upper New York state. Its entire system has a rated capacity of 2,186,451 kw with 600,000 kw now under construction.

A current example of their enterprise is the Oswego Steam station, designed by their engineering department with construction supervision by Stone & Webster Engineering Corporation.

The benefits of competent business management of a privately-owned utility are again demonstrated by the Niagara-Mohawk system.

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY *of* STONE & WEBSTER, INC.

How to Work at FULL TILT and lose less than ever!

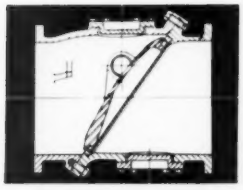
INSTALL

CHAPMAN

Tilting-Disc Check Valves

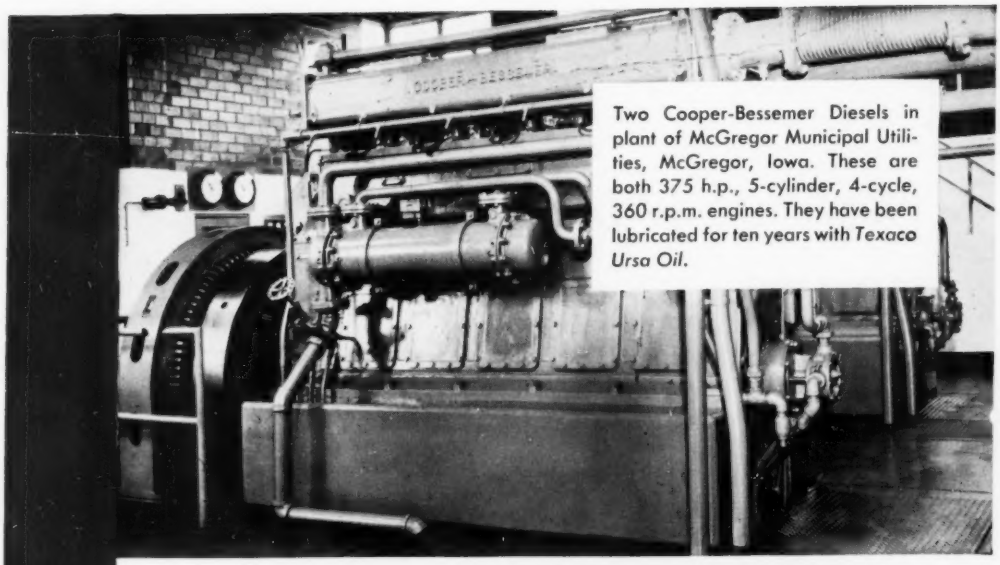
Take another look at the diagram below. That tilting disc actually *balances as it closes* . . . so that it cushions itself into a drop-tight seat . . . without any slamming under usual piping arrangements.

This means far lower head loss than with other types of check valves. It means, too, far lower rate of wear of moving parts . . . for the disc is the *only* moving part. In fact, it means more savings and less trouble than you ever knew you could get with *any* check valve. Write for Catalog No. 30, giving complete test results at some of the country's leading engineering laboratories.



Cross-section of the Chapman Tilting-Disc Check Valve. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.

THE CHAPMAN VALVE MFG. CO.
INDIAN ORCHARD, MASSACHUSETTS



Two Cooper-Bessemer Diesels in plant of McGregor Municipal Utilities, McGregor, Iowa. These are both 375 h.p., 5-cylinder, 4-cycle, 360 r.p.m. engines. They have been lubricated for ten years with *Texaco Ursa Oil.*

"We've used TEXACO URSA OIL for over 10 years and can state that it

KEEPS DIESELS CLEAN ...KEEPS COSTS LOW"

— says Raymond A. Trygg, Superintendent, McGregor (Iowa) Municipal Utilities

Mr. Trygg states further regarding the outstanding performance of *Texaco Ursa Oil:* "When our Diesels were last opened up — for their first inspection in two years—they were found to be clean and there was no measurable wear on pistons, rings, liners or bearings."

Because of the exceptional engine cleanliness assured with *Texaco Ursa Oil,* operators everywhere get longer parts life, lower maintenance costs, less fuel consumption, lube oil economy. Latest annual figures, for example, show that McGregor gets 12,469 h.p. hours per gallon of *Texaco Ursa Oil.*

Whether you're operating Diesel, gas or dual-fuel engines, there is a *Texaco Ursa Oil* that is exactly right for the size and type of your engines, and your particular operating conditions. Leading engine builders approve *Texaco Ursa Oils,* and they are easily America's favorite. In fact —

For over 15 years, more stationary Diesel h.p. in the U.S. has been lubricated with Texaco than with any other brand.

Let a Texaco Lubrication Engineer help you keep your Diesel efficiency high, your costs low. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO URSA OILS

FOR ALL DIESEL, GAS AND DUAL-FUEL ENGINES

Faithfully yours 50 *for Fifty Years*

TUNE IN: Tuesday nights on television—the TEXACO STAR THEATER starring MILTON BERLE. See newspaper for time and station.